CHAPTER 4

Environmental Consequences

Trumpeter Swans. Photograph by Nancy J. Curry

This chapter analyzes and compares the effects anticipated under each alternative, assuming each alternative would be implemented as described in Chapter 2. In general, the spatial framework for analysis is the Study Area, and the time period considered is the next fifteen years. Effects are considered in four main topic areas: species and habitats, social, economic, and cultural. Within each topic area we have chosen the key indicators of concern for evaluation. These indicators highlight the key resource values under the topic of consideration. Each indicator is assessed for the effects that would occur to it by implementation of the land protection actions, public use actions, and elk management actions proposed under the different alternatives. For analysis purposes, elk hunting programs are assessed under the public use actions sections.

A summary of the overall chapter and analysis is found in Table 4-1. The effects are summarized using words or phrases (minimal, decrease, increase, stable, declining) to characterize the effect on the indicator. A short narrative is also provided to further explain the effect. Where possible numeric quantities from tables within the chapter are provided to ease comparisons of the alternatives.

4.1 EFFECTS TO SPECIES AND HABITATS

4.1.1 INDICATOR 1-EFFECTS TO WATER QUALITY AND QUANTITY

Effects from land protection actions

Land protection actions can have a very large impact on Refuge water quality and quantity, because the proximity and growth of the Spokane metropolitan area is probably the greatest threat to water quality and quantity within the Turnbull NWR. The principal land protection differences between alternatives are the sizes of the Stewardship Area and the acres of habitat potentially acquired for inclusion in the National Wildlife Refuge System. Under all alternatives a Stewardship Area would be designated, and within this area the Refuge would focus outreach and education programs to increase landowner participation in voluntary conservation programs protecting water quantity and quality, and protecting and restoring additional habitat. The Stewardship Area measures a total of 21,396 acres in Alternative 1 and 44,536 acres in Alternatives 2, 3, and 4. The Stewardship Area by itself under Alternatives 1 and 2 would not constitute an expansion of the current Approved Refuge Boundary. In Alternatives 3 and 4, an expanded Approved Refuge Boundary is proposed. Within this boundary, the Service would seek to purchase land or an interest in land from willing sellers (contingent on funding) to increase the size of the Refuge and further conservation efforts.

Both the conservation programs of the Stewardship Areas and the land acquisition potential of an expanded Refuge boundary rely on voluntary and willing participants. Since their numbers are largely unknown, it is difficult to estimate the effectiveness of each of the alternatives in protecting and restoring water quality and quantity. However, the larger the land base, the more opportunities there will be to protect and restore water quality and quantity. It is assumed that land acquisition within an expanded Refuge boundary would be more effective in fully protecting and restoring water quality and quantity than the Stewardship Area conservation programs, because the acquisition would remove any constraints imposed by the economic and personal needs of the private landowner. Land acquisition by the U.S. Fish and Wildlife Service may be the best remaining opportunity to protect habitat and Refuge water quality and quantity from adverse land use changes.

The Stewardship Area for Alternative 1, identified in the Refuge's Habitat Management Plan, was defined to protect watersheds northeast of the Refuge that were felt to be at the highest risk from development. The Stewardship Area also included a one-mile wide buffer zone around the Refuge where excessive

Table 4.1 *Summary of effects of alternatives on biological, social, economic, and cultural resource indicators.* [1]

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Effects to Water Quality and Water Quantity				
Input of phosphorus and nitrogen into refuge wetlands	**Increased N and P inputs:** An estimated 1,342 acres (3% of the Study Area) would be protected over the next 15 years, resulting in little change in existing trends of agricultural run-off or the number of additional septic systems projected to be installed within the Refuge surface watershed over the next 15 years.	**Increased N and P inputs:** An estimated 2,683 acres (6% of the Study Area) would be protected over the next 15 years, resulting in slight improvements that would not substantially offset nutrient input from new hobby farms and additional septic systems.	**Stabilized N and P inputs:** This alternative would potentially result in 600 fewer new septic systems installed within the Refuge surface watershed, and would also result in partially reduced agricultural inputs to Refuge watersheds. These improvements would, however, only offset increased inputs from septic systems and hobby livestock, thus resulting in similar levels of nutrient inputs to Refuge wetlands as presently.	**Decreased N and P inputs:** This alternative would potentially result up to 1,200 fewer new septic systems and would also result in reduced livestock grazing within wetland basins that drain onto the refuge thereby decreasing the total input of phosphorus and nitrogen and substantially improving water quality.
Inflow to refuge wetlands from surface drainages and groundwater	**Declining Water Tables:** Up to 2,000 additional wells could be drilled for domestic use as the area is sub-divided over the next 15 years, further reducing groundwater resources .	**Declining Water Tables** Fewer wells would be developed in the 1-mile groundwater buffer area, but some declines in water levels in the shallow aquifer would still be expected in the long-term.	**Stable Water Tables** The number of new wells expected would be one third less than under Alternative 1, resulting in stabilizing water levels in the shallow aquifers.	**Increased Water Tables** The potential number of new wells would be reduced by 1,200. In conjunction with increased wetland restoration activities, aquifer recharge should raise the water table reducing surface water losses to groundwater recharge.

[1] Alternatives are distinguished based on actions in three main areas: land protection, public use, and elk management. For a detailed description of alternative actions in these areas, see Chapter 2. To summarize land protection actions briefly here, Alternative 1 includes land protection actions that rely on landowner participation in voluntary conservation programs and partnership activities within a small designated Stewardship Area. Alternative 2 also relies on voluntary conservation but includes some funding for outreach and designates a larger Stewardship Area. Alternative 3 includes voluntary measures and also provides for protection, under the National Wildlife Refuge System, of up to 12,000 acres, by fee, easement, or cooperative agreement within the Stewardship Area. Alternative 4 is similar to Alternative 3 but provides for protection of up to 25,000 acres by fee, easement, or cooperative agreement.

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Effects to Wetland Habitats and Populations of Wetland-Associated Species				
Cumulative Effects on Area and Effectiveness of Wetland Habitat	**Declining Faster** This alternative could result in the protection and restoration of 261 acres of altered wetlands (5% of the Study Area), but most wetland habitat in the area would still be expected to decline in quality due to trends in water quality and quantity.	**Declining Slower** This alternative could result in 522 acres of wetlands protected and restored, but most wetland habitat in the Study Area would still be declining in quality due to trends in water quality and quantity.	**Stable to Increasing** Alt. 2 could result in 2,102 acres of altered wetlands restored, which equates to approximately 40% of the altered wetland acreage of the Study Area. This would offset continued wetland losses on other unprotected lands in the Study Area.	**Increasing** Alt. 4 could result in 3,627 acres of altered wetlands restored (72% of the altered wetland acreage in the Study Area). This level of conservation effort would more than offset any losses on the remaining unprotected acres in the Study Area.
Percent of refuge wetland habitat impacted by public uses: Spring/Summer Fall	18% 18%	10% 10%	12% 30% (18% of the fall wetland habitat would be affected only on 2 days/yr during the youth waterfowl hunt)	12% 35%
Waterfowl Breeding pairs • Number of pairs (% increase over current) • Fall use days (% increase)	480 (11%) 80,218 (13%)	961 (23%) 161,121(27%)	4,114 (88%) 622,755(103%)	7,501 (159%) 1,123,054 (186%)
Waterbird and shorebird populations: percent increase over current levels	13%	27%	103%	186%
Overall effects on populations of wetland associated wildlife	**Decreasing Populations** Small increases in the wetland area protected and restored within the Study Area would not offset declines in remaining altered and unprotected wetlands. Human disturbance of 18% of the existing refuge wetlands would contribute to declines in populations of wetland species.	**Decreasing Populations** Moderate increases in the wetland area protected and restored would not offset declines in remaining altered and unprotected wetlands.	**Stable to increasing populations** Significant restoration of altered wetland habitat and protection of existing intact wetlands would result in population increases that would offset expected losses on the remaining altered and unprotected wetlands.	**Increasing populations** Restoration and protection of an estimated 72% of the wetlands in the Study Area would result in substantial increases in populations of wetland associated wildlife during the breeding season and fall migration period.

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Effects to Steppe Habitats and Populations of Steppe-Associated Species				
• Acres of high and medium quality steppe within Stewardship Zone	6,380	10,278	10,278	10,278
• Acres potentially protected and restored	370	740	4,340	8,240
Percent of refuge steppe habitat negatively affected by public uses	20%	11.7%	13.5%	13.5%
Cumulative effects on area and effectiveness of steppe habitat from all proposed actions	**Declining Faster** An overall decline in the integrity of steppe habitats from increased fragmentation, invasive species, and development is expected in the Study Area.	**Declining Slower** A net decline in the biological integrity of steppe habitat is expected in the Study Area.	**Stable to Increasing** Additional opportunity to fully protect and restore larger tracts of high quality steppe habitat in the Study Area would offset losses resulting from sub-division and development.	**Improving** Additional opportunity to protect and restore most of the high quality steppe habitat in the Study Area would result in an overall improvement in the condition of steppe habitats within the vicinity of the refuge.
Cumulative effects on steppe associated wildlife (eg. grasshopper, vesper, lark, and savannah sparrows)	**Declining Faster** Nesting populations of steppe associated birds in the Study Area would be expected to decline as a result of the net loss of the biological integrity of steppe habitat and increased disturbance in the refuge Public Use Area.	**Declining Slower** Nesting populations of steppe associated species in the Study Area would be expected to decline as a result of the loss of the biological integrity of the remaining unprotected steppe habitat.	**Stable to Increasing** Restoration and protection efforts under this alternative would offset losses from development and land conversion, stabilizing or slightly increasing populations of steppe associated species.	**Increasing** Net increases in the area and biological integrity of steppe habitats within the Study Area would increase nesting populations and productivity of associated wildlife species.
Effects to Ponderosa Pine Habitats and Populations of Ponderosa Pine-Associated Species				
Acres of high and medium quality pine habitat in the Stewardship Area	7,582	14,778	14,778	14,778
Acres potentially protected and restored	629	1,258	7,378	14,008

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Percent of Refuge ponderosa pine habitat affected by public uses	11%	2%	2.6%	2.6%
Cumulative effects to ponderosa pine habitat	**Declining Faster** Many large landholdings in the Study Area would continue to be sub-divided and developed resulting in an overall decline in the integrity of pine habitats in the Study Area.	**Declining Slower** Habitat losses, degradation and fragmentation would continue to occur, but at a slower rate than in Alt. 1.	**Stable to Improving** Additional opportunity to fully protect and restore larger tracts of ponderosa pine habitat in the Study Area would offset losses from sub-division and development.	**Improving** The opportunity exists to protect and restore the vast majority of high quality pine habitat in the Study Area, improving the overall availability and condition of pine habitats in the Study Area.
Effects to associated wildlife	**Declining Faster** Species requiring large blocks of mature pine forest would decline in the area as property is sub-divided and cleared for homes. Cavity-using wildlife species requiring large diameter trees would be the most impacted.	**Declining Slower** Species requiring large blocks of mature pine forest would decline in the area, but at a slower rate than in Alt. 1. Cavity-using wildlife species requiring large diameter trees would be the most impacted.	**Stable to Increasing** Protection and restoration of substantial areas of ponderosa pine forest would stabilize populations of species requiring large blocks of mature pine forest. Cavity-using wildlife species requiring large diameter trees would be the most benefited.	**Increasing** Species requiring large blocks of mature pine forest would increase in the area as protection and restoration take place on 72% of the pine habitat in the Study Area. Cavity-using wildlife species requiring large diameter trees would be the most benefited.
Cumulative Effects to Forest Connectivity	Continued sub-division of larger forested tracts north of the refuge would result in fragmentation and erosion of forest connectivity.	Forest connectivity would still slowly decline over time.	This alternative would help maintain minimally effective linkages to other forested zones.	This alternative would create fully effective linkages to other forested zones.
Effects to Aspen / Riparian Habitats and Populations of Aspen / Riparian Associated Species				
Acres of high and medium quality aspen /riparian habitat within the Stewardship Area	233	363	363	363
Estimated acres protected and or restored	12	24	144	274
Percent of Refuge habitat affected by publicuses	19%	3%	4%	4%

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cumulative Effects on the area and effectiveness of aspen / riparian habitat from all proposed actions.	**Declining Faster** Little impact of Refuge programs on land use trends, thus, many large landholdings would continue to be sub-divided and developed resulting in an overall decline in the integrity of aspen habitats in the Study Area.	**Declining Slower** Some impact of Refuge programs on land use trends, however, land clearing and fragmentation would continue, resulting in an overall decline.	**Stable to Increasing** Larger impact of Refuge programs on land use trends, thus would provide additional opportunity to fully protect and restore larger stands and aggregations of aspen habitat in the Study Area, offsetting losses and declining quality in remaining unprotected areas.	**Increasing** The opportunity exists to protect and restore the vast majority of aspen habitat within the Study Area.
Cumulative Effects to aspen / riparian associated wildlife (especially deciduous forest dependent species, such as red-naped sapsucker, willow flycatcher, and yellow warbler)	**Declining Populations** Decline expected in populations of most deciduous forest dependent species within the Study Area. Increasing visitation and the lack of adequate controls within the Public Use Area would result in declines in these species on the refuge.	**Declining Populations** Decrease in most deciduous forest dependent species.	**Stable to Increasing** Stable populations of deciduous forest dependent species would be expected.	**Increasing** Increased populations of deciduous forest dependent species would be expected.
Effects to threatened and endangered species				
Acres of potential Spalding's silene habitat in Stewardship Area	4,256	6,502	6,502	6,502
Estimated acres protected and restored	358	605	2,575	4,700
Spalding's silene - Cumulative Effects	**Declining Faster** Little impact of Refuge programs on land use trends, thus expected degradation and loss of existing Silene habitat and populations under this alternative.	**Declining Slower** Losses due to sub-division and development would continue to occur on the remaining unprotected areas, at a rate slower than Alt. 1.	**Stable to Increasing** Additional opportunity to fully protect and restore larger tracts of high quality steppe habitat in the Study Area would be available, thereby offsetting losses of Silene habitat on the remaining unprotected lands.	**Improving** Opportunity would exist to protect and restore the vast majority of remaining high to medium quality steppe habitat in the Study Area, thus protecting nearly all available Silene habitat within the Study Area..

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Number of *Howellia* wetlands in Stewardship Area	200	400	400	400
Total acreage of potential *Howellia* wetlands	454	885	885	885
Estimated acres protected and restored	38	82	350	640
Water Howellia - Cumulative Effects	**Declining Faster** Expected losses in *Howellia* habitat resulting primarily from declines in water quantity resulting from excessive groundwater withdrawals.	**Declining Slower** Expected losses in *Howellia* habitat resulting from declines in water quantity resulting from excessive groundwater withdrawals.	**Stable to Increasing** Additional opportunity to fully protect and restore potential *Howellia* habitat in the Study Area thereby offsetting losses on the remaining unprotected lands.	**Increasing** Protection and restoration of the vast majority of *Howellia* habitat in the Study Area. would be expected.
Fall and winter bald eagle habitat - Cumulative effects	**Declining Faster** Increasing development around existing permanent water sources and potential declines in water quantity would result in an overall decline in fall /winter bald eagle habitat.	**Declining Slower** Increasing development around unprotected permanent water sources and potential declines in water quantity would result in an overall decline in fall /winter bald eagle habitat.	**Stable to Increasing** The potential exists to double the area of protected bald eagle habitat within the Study Area, offsetting any losses on the remaining unprotected and altered habitat in the Study Area.	**Increasing** Expected protection and restoration within the Study Area would more than offset any losses on the remaining unprotected and altered habitat resulting in an increase in fall/winter bald eagle use.
Acres within Stewardship Areas	118	351	351	351
Estimated acres protected and restored	104	208	890	1,624
Percent of existing refuge bald eagle habitat potentially affected by public use actions	18%	22%	40%* *(14% of the Refuge habitat would only be impacted 2 days/yr during youth waterfowl hunt)	54%

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Social Effects				
Opportunities for compatible nature/wildlife observation and birdwatching	**Declining** Reduced viewing opportunities would be expected due to declining populations of local wildlife and increased human disturbance associated with higher expected visitation, no trail restrictions and lack of screened viewing areas.	**Declining** Additional viewpoints and trails would improve access to viewing areas. Human disturbance would be reduced by restricting visitors to trails and viewpoints, but expected declines in wildlife populations around the refuge due to development would reduce viewing opportunities.	**Increasing** Expansion of the Public Use Area as well as additional trails and viewpoints would provide greater access and opportunity to view wildlife. Land protection actions would result in increased wildlife populations increasing the probability of observing wildlife, and would also result in the potential to provide more viewing areas in the future.	**Substantially Increasing** Expansion of the Public Use Area, as well as additional trails and viewpoints would provide greater access and opportunity to view wildlife. Land protection actions would result in increased wildlife populations and the potential to to provide more viewing areas.
Opportunities for compatible non–motorized trail activities and longer trail loop options	**No Change** No loop trails and no trail longer than 1.5 mile.	**Minimal Increase** Stubblefield Lake Loop added.	**Moderate Increase** Trail loops include Stubblefield Lake Trail and Public Use Area / Columbia Plateau Trail Connector. Potential trails on new additions.	**Moderate Increase** Trail loops include Stubblefield Lake Trail and Public Use Area / Columbia Plateau Trail Connector. Potential trails on new additions.
Miles of Trails	11.25	15.25	15.25	15.25
Opportunities for increasing numbers of destination visitors	**No Change**	**Moderate** An additional trail, viewpoints, expanded interpretation and environmental education programs, and an elk hunt would increase the number of destination visitors.	**Moderate** Additional trails, viewpoints, greatly expanded interpretation and environmental education programs, elk hunting, and a youth waterfowl hunt would all make Turnbull NWR more attractive to destination visitors.	**High** Additional trails, viewpoints, a new visitor center, greatly expanded interpretation and environmental education programs, elk and waterfowl hunts would all make the Refuge much more attractive to destination visitors.
Opportunities for quality hunting	**None**	**Minimal Increase** Only an elk hunt would be offered, with the objective of reducing impacts to aspen communities. Without an acquisition program no additional hunting areas would come available.	**Moderate Increase** An annual elk and youth waterfowl hunt on the existing Refuge area and the potential for additional hunting opportunities on up to 12,000 acres of new acquisitions would increase opportunities for a quality hunt.	**Substantial Increase** An annual elk and fall waterfowl hunt on the existing Refuge area and the potential for additional hunting opportunities on up to 25,000 acres of new acquisitions would substantially increase opportunities for a quality hunt.

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Opportunities for a compatible and sustainable Environmental Education program both on-Refuge and off-Refuge	**Minimal and Variable** Reliance on volunteers and soft money results in inconsistent service to the community and stalled program development Program would continue to serve from 3,000 to 8,000 students with high annual variability. Most activities would be self-facilitated. Off-Refuge EE would not be facilitated.	**Moderate and Stable** Addition of seasonal staff would allow for a more stable service and improved program development but facilities and year-round support would continue to limit the capacity of the program to between 4,000 and 8,000 students depending on volunteer recruitment. Ten percent of the off-Refuge program would be facilitated.	**High** Addition of year-round staff and a second classroom would greatly expand the quality and capacity of the program allowing the Refuge to serve up to 10,000 students annually on-Refuge and about 4,500 students off-Refuge. About 25% of the off-Refuge program would be facilitated.	**Very High** Construction of a new environmental education center and year-round staff would result in the program becoming a regional role model providing teacher in-service training, and hosting up to 12,000 students throughout the year and conducting off-Refuge program for up to 10,000 students .
Environmental justice	**Neutral** Proposed programs have a low risk of adversely affecting human health, or the social environment as most anticipated effects are positive. Minority and low-income populations do not appear to be at risk for disproportionately adverse effects from the proposed alternative.			
Contribution of Refuge Operations to the Regional Economy				
Effects from expenditures on operations and maintenance: • Total employment • Annual income	39 $ 882,000	39 $ 890,000	57 $ 1,321,000	63 $ 1,483,000
Effects from one-time expenditures (special projects): • Total employment • Annual income	52 $ 936,000	62 $ 1,032,000	90 $ 1,403,000	100 $ 1,677,000
Contribution of Refuge Recreation to the Regional Economy				
Effects from visitor expenditures on non-consumptive recreation at Refuge: • Total employment • Annual income	80 $ 1,251,000	86 $1, 348,000	99 $ 1,570,000	110 $ 1,741,000

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Effects from visitor expenditures on hunting at Refuge: • Total employment • Annual income	 0 0	 <1 $3,600	 <1 $3,600	 2 $ 22,700
Effects from Land Conservation on the Regional Economy				
Effects from reduction in agricultural production on acquired lands • Lost employment • Lost annual income	 -6 - $ 41,550	 -6 - $ 41,550	 -22 - $ 141,300	 -27 - $ 186,900
Effects of Refuge Land Acquisition on Local Tax Revenues				
Estimated loss of property taxes and timber excise taxes on acquired lands	- $ 8,559	- $8,559	- $29,091	- $38,515
Estimated federal in-lieu of property tax payments on Refuge lands	$ 35,806	$ 35,806	$ 45,541	$ 50,002
Consumer Surplus Value of Refuge				
Estimated annual recreation benefits at Refuge (consumer surplus)	$ 1, 643,750	$ 1, 777, 330	$ 2,068,580	$ 2,325,630

Indicator	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Effects to Refuge Cultural Resources				
Risk of damage to or loss of archaeological and historical sites	Minimal construction activity would reduce risk to cultural resources. Increasing visitation might increase risk for vandalism.	Additional trails, viewpoints and facilities would increase damage risk to cultural resources as would resulting increases in visitation.	Expanded public use facilities and projected increases in public use create a high risk of damage and vandalism on Refuge. Risk to cultural resources within the Study Area could be somewhat lower than at present.	With the most facility construction and highest projected visitor use, this alternative has the greatest potential for damage to cultural resources on Refuge. Risk to cultural resources within the Study Area would be somewhat lower than at present.
Opportunities for cultural resource education	Moderate opportunity with variable resources to administer program.	Moderate opportunity with stable resources to administer program.	High opportunity, with stable resources to administer program.	Very high opportunity, with stable resources to administer program.

groundwater removal could negatively impact Refuge wetlands. Thirty-two percent of the Refuge surface watersheds fall within this Stewardship Area (Table 4-2). It is expected that Alternative 1 would have negligible impact on water quality and quantity, because it relies strictly on private land conservation programs, and the Stewardship Area includes only 28 percent of the Company Ditch which supports the greatest proportion of Refuge wetlands. Projected participation in voluntary landowner incentive programs and partnership activities will protect only 3 percent (1,342 acres) of the Stewardship Area in the next 15 years. This effort will not significantly reduce current levels of agricultural run-off or the number of new wells and septic systems, resulting in increased inputs of nitrogen and phosphorus to wetlands, and groundwater withdrawals exceeding recharge.

The Stewardship Area for Alternatives 2, 3, and 4 is nearly double the size of the Alternative 1 Stewardship Area. Fifty-six percent of the Refuge surface watersheds are included, as well as all of the one-mile wide, groundwater protection zone. Ninety-five percent and 62 percent of the Kaegle and Company Ditch drainages, respectively, are included in the proposed Stewardship Area for these alternatives (see Table 4-2). These subwatersheds provide input to over 80 percent of the Refuge's managed wetlands. Because of the larger Stewardship Area and the addition of outreach staff, the proposed actions under Alternative 2 are expected to protect about 2,683 acres (about six percent of the Stewardship Area) from development that could result in increased nutrient inputs or overuse of groundwater resources. These improvements, however, will not offset nutrient input from new hobby farms and additional septic systems and excessive groundwater withdrawals for new wells on the remaining unprotected areas of the Stewardship Area.

Alternatives 3 and 4 expand the current Approved Refuge Boundary to the extent of the Stewardship Area, but place a cap on the maximum number of acres the Service would acquire an interest in over the next 15 years. Under Alternative 3, purchase of easements or fee title acquisition of up to 12,000 acres in addition to landowner participation in voluntary conservation programs and partnership activities will reduce the potential number of new septic systems and wells by up to 600. Agricultural activities within wetland basins that drain onto Refuge will likely be reduced as restorations are completed. These improvements will off-set increased nutrients inputs from septic systems,

Table 4-2. *Acreage[a] and Percent of each Refuge Surface Subwatershed Contained within Stewardship Areas and Estimated Area Protected or Restored*

	Alt 1	Alt 2	Alt 3	Alt 4
Stewardship Area				
Company	1,217 (28%)	2,736 (62%)	2,736 (62%)	2,736 (62%)
Kaegle	830 (49%)	1,628 (95%)	1,628 (95%)	1,628 (95%)
Phillips	1,781 (26%)	6,460 (93%)	6,460 (93%)	6,460 (93%)
Philleo	3,421 (36%)	1,690 (18%)	1,690 (18%)	1,690 (18%)
Total	*7,249 (32%)*	*12,514 (56%)*	*12,514 (56%)*	*12,514 (56%)*
Area protected or restored				
Acres	1,342	2,683	14,683	27,683
Percent of Stewardship Area	3%	6%	33%	62%

[a] Assumptions on acreage are as follows: Alt 1 acres is equivalent to the number of acres protected or restored over the past ten years within the Study Area, extrapolated over the next 15 years. Alt 2 acres is twice the effort in Alt 1. Alt3 acres is 12,000 acres acquisition cap plus the private land effort equivalent to Alternative 2. Alt 4 acres is 25,000 acres acquisition cap plus the Alt 2 Private Land effort.

hobby livestock, and groundwater withdrawals on the remaining unprotected area. Actions likely under this alternative will have the effect of maintaining or slightly decreasing existing levels of nutrient inputs to Refuge wetland and stabilizing or slightly increasing current water quantities.

Purchase of easements or fee title on up to 25,000 acres under Alternative 4 in addition to projected landowner participation in voluntary conservation programs and partnership activities will reduce both the potential number of new septic systems and wells by up to 1,200, as well as agricultural activities within wetland basins that drain onto the Refuge. This level of protection would decrease the total input of phosphorus and nitrogen substantially improving water quality. In conjunction with limitations on groundwater withdrawals, wetland restoration activities should increase aquifer recharge and raise the water table thereby reducing surface water losses to groundwater recharge.

Effects from elk management actions (Not including hunting)

There are no anticipated impacts to water quality and quantity from any of the elk management actions.

Effects from Public Use Actions

There are no anticipated impacts to water quality and quantity from any of the Public Use actions.

4.1.2 Indicator 2 - Effects to the Wetlands Habitat Base and Associated Wildlife Species

Effects from land protection actions

With over 70 percent of the wetland basins in the vicinity of the Refuge already altered from drainage and agricultural use, numerous opportunities exist to protect and restore additional wetland habitat through implementation of land protection actions.

Table 4-3 compares the wetland habitat area included within the alternative Stewardship Areas and the estimated acres protected and restored given the alternative land protection actions. Table 4-4 and 4-5 compare the estimated response of breeding and migratory waterfowl to the different land protection alternatives.

The effectiveness of the alternatives in protecting and restoring the historic composition of wetlands in the Refuge vicinity increases from Alternative 1 through 4. This increase results from enlarging the size of the Stewardship Area, increasing outreach efforts for voluntary conservation programs, and adding land acquisition as a land protection strategy.

Alternative 1 includes approximately 3,900 acres of historic wetlands in its Stewardship Area. Over 7,000 historic wetland acres are included in the Stewardship Area of Alternatives 2, 3, and 4. The Stewardship Area of Alternatives 2, 3, and 4 also includes almost twice the area of historically semi-permanent and permanent wetlands than Alternative 1. These wetland types were the most impacted by past drainage activities and are critical to the breeding success of most wetland-dependent wildlife, as well as providing important fall use to waterfowl and fall/winter use to bald eagles.

Both Alternative 1 and 2 rely strictly on partnership activities and voluntary private land conservation programs to restore and protect wetlands. Projected participation in voluntary land conservation programs within the Stewardship Area of Alternative 1, in combination with conservation partner activities, will result in the protection and restoration of approximately 9 percent of the altered wetlands. Increased outreach efforts under Alternative 2 with additional staff and a larger Stewardship Area will result in a doubling of the area of wetlands protected and restored through voluntary conservation programs. These efforts, however, will not offset continuing wetland loss and degradation on the remaining unprotected lands, resulting in a decreasing wetland base and a decline in wetland associated wildlife.

Many landowners in the Stewardship Areas are economically dependent on drained wetlands to produce hay or pasture for their livestock. This dependence is one of the reasons few of the large landowners have participated in conservation programs to restore altered wetlands. Both Alternative 3 and 4 include land acquisition as a land protection strategy which could provide an alternative compensation mechanism for landowners. The potential to acquire 2,819 acres of wetlands in Alternative 3, and 5,139 acres in Alternative 4, would allow restoration of 2,012 acres and 3,627 acres under Alternative 3 and 4, respectively.

Table 4-3. *Current and Historic Acreage of each Wetland Type within Altered Basins of theAlternative Stewardship Areas and Estimated Area of each Wetland Type Potentially Protected or Restored.*

	Alt 1	Alt 2	Alt 3	Alt 4
Current Wetland Composition [a]				
Permanent	165	464	464	464
Semi-permanent	397	773	773	773
Seasonal	2,029	4,089	4,089	4,089
Temporary	1,974	1,378	1,378	1,378
Total	3,645	6,704	6,704	6,704
Historic Wetland Composition [b]				
Permanent	1,223	2,247	2,247	2,247
Semi-permanent	925	1,685	1,685	1,685
Seasonal	894	1,628	1,628	1,628
Temporary	851	1,550	1,550	1,550
Total	3,903	7,110	7,110	7,110
Estimated Acres of Current Wetland Type Potentially Protected [c]				
Permanent	15	45	194	354
Semi-permanent	36	76	324	591
Seasonal	183	401	1,719	2,134
Temporary	95	135	581	1,058
Total	330	659	2,819	5,139
Estimated Acres of each Wetland Type Restored [d]				
Permanent	98	197	760	1,370
Semi-permanent	66	132	513	924
Seasonal	48	97	374	674
Temporary	47	94	364	656
Total	261	522	2,012	3,627

[a] Derived from National Wetland Inventory Maps

[b] Product of the percent composition of a wetland type on Turnbull NWR, a fully restored sample, and the number of potential wetland acres in the Stewardship Area of the Channeled Scablands

[c] Product of the current percent composition of each wetland type within the Stewardship Area and the estimated wetland acres protected under an alternative.

[d] The difference between the acres of each current wetland type and the historic acres of each wetland type in the protected area.

Table 4-4. *Estimated Duck Breeding Pairs Expected on Restored and Protected Wetlands within the Alternative Stewardship Areas.*

Species	Alt 1	Alt 2	Alt 3	Alt 4
MALLARD	73	146	623	1136
GADWALL	26	53	225	410
WIGEON	4	8	34	62
G.W. TEAL	15	30	128	234
B.W. TEAL	18	36	154	281
C. TEAL	47	94	402	733
SHOVELER	13	26	110	200
PINTAIL	3	7	29	52
WOOD DUCK	3	6	27	48
TOTAL DABBLERS	202	404	225	3156
REDHEAD	111	222	949	1730
CANVASBACK	6	12	51	94
L. SCAUP	15	30	128	234
RING-NECK	26	52	224	408
BUFFLEHEAD	18	37	157	287
RUDDY DUCK	105	209	896	1634
TOTAL DIVERS	281	562	2406	4387
TOTAL DUCKS	**480**	**961**	**4114**	**7502**

*The product of breeding pair densities (pairs/wetland acre) on the Refuge (a fully restored landscape) and the estimated wetland acres protected and restored

The result of this substantial addition of semi-permanent and permanent wetland habitat will offset losses on unprotected lands resulting in stable to increasing populations of wetland associated wildlife especially waterfowl, marshbirds and shorebirds.

Effects from Elk Management Actions (Not including hunting)

No impacts anticipated.

Effects from Public Use Actions

The principal impact of public use programs on wetland habitats and wildlife are associated with visitors on foot engaged in bird watching, wildlife observation, photography, hunting, and environmental education activities. Numerous studies have confirmed that people on foot can cause a variety of disturbance reactions in wildlife, including flushing or displacement (Erwin 1989, Fraser et al. 1985, Freddy 1986), heart rate increases (MacArthur et al. 1982), altered foraging patterns (Burger and Gochfeld 1991), and even, in some cases, diminished reproductive success (Boyle and Samson 1985). These studies and others have shown that the severity of the effects depends upon the distance of the disturbance to the animal(s) and the disturbance's duration, frequency, predictability, and visibility to wildlife (Knight and Cole 1991).

Variables that typically have the greatest influence on wildlife behavior are the distance from the animal to the disturbance and the duration of the disturbance. In a review of several studies of the reaction of waterfowl and other wetland birds to people on foot, distances greater than 328 feet (100 meters) generally did not result in a behavioral response (DeLong 2002). The area of wetlands within 328 feet of public activity centers and hunting areas

Table 4-5. *Estimated Fall Duck use Days Expected on Restored and Protected Wetlands within the Alternative Stewardship Areas**

Species	Alt 1	Alt 2	Alt 3	Alt 4
MALLARD	59,768	119,470	511,772	933,071
GADWALL	7,923	15,838	67,843	123,693
WIGEON	7,201	14,395	61,663	112,424
G.W. TEAL	2,132	4,261	18,254	33,282
B.W. TEAL	1,179	2,358	10,099	18,413
C. TEAL	316	632	2,709	4,940
SHOVELER	449	898	3,845	7,010
PINTAIL	4,860	9,714	41,612	75,867
TOTAL DABBLERS	83,829	167,566	717,797	1,308,700
REDHEAD	455	910	3,899	7,108
CANVASBACK	520	1,040	4,456	8,124
L. SCAUP	1,746	3,490	14,949	27,254
RING-NECK	1,158	2,315	9,918	18,082
BUFFLEHEAD	327	654	2,803	5,110
RUDDY DUCK	1,041	2,080	8,912	16,248
TOTAL DIVERS	5,248	10,490	44,964	81,927
TOTAL DUCKS	89,077	178,056	762,733	1,390,627

*The product of the duck use days per acre of permanent wetland on the Refuge (a fully restored landscape) and the estimated acres of permanent wetland protected and restored under each alternative

therefore provides an indicator to evaluate the effects of the alternatives on wetland wildlife (Table 4-6). It is important to note that these areas also include the portions of wetlands that are not visible from trails or other public use facilities. There is also some overlap in the buffer areas associated with different facilities types.

Trails: Based on the analysis displayed in Table 4-6, trails have the highest potential of any public facility type to result in disturbance to wetland wildlife, with the exception of hunting areas. Although Alternative 1 has the least amount of wetland acres within 328 feet (100 meters) of public use facilities, including trails (see Table 4-6), it has the greatest potential to impact wetland wildlife because visitors are currently free to roam off-trail year-round within the entire Public Use Area. Continuation of this unrestricted use policy, with probable increases in future visitor numbers, would likely result in significant disturbance to wetland wildlife and less wildlife in the Public Use Area. The 2,200-acre Public Use Area has 546 acres of wetlands representing 18.2 percent of the total Refuge wetland base.

Alternatives 2, 3, and 4 would implement regulations restricting foot travel to trails-only during the nesting season to minimize wildlife disturbance which could result in reduced foraging time, abandonment of nest and young, increased predation of nests and young, and trampling of habitat.

The Stubblefield Lake Loop is a new 3.7-mile trail proposed in Alternatives 2, 3, and 4. With use restricted to the trail year round, hikers would not be allowed to approach any wetland area close enough to disturb waterfowl or other water birds. If individuals do not comply with regulations prohibiting off-trail use, the potential does exist for disturbance to waterfowl and waterbirds using this wetland. Law enforcement efforts are expected to keep this type of violation to a minimum. Outside the Public Use Area, the Columbia Plateau Trail (CPT) crosses 4.75 miles of the Refuge where individuals on foot, bicycle and horseback pass within 100 feet and in full

Table 4-6. *Area of Wetlands (acres) within 328 feet of Public Areas[a] and the Percentage of the Refuge Wetland Base Potentially Impacted by Public Use of Each Area.*

Public Use Facility	Alt 1	Alt 2	Alt 3	Alt 4
Trails				
Acres	202	227	266	266
percent of Refuge wetlands	6.7%	7.6%	8.9%	8.9%
EE sites				
Acres	10	10	10+[b]	10+[b]
percent of Refuge wetlands	0.3%	0.3%	0.3%	0.3%
Viewpoints				
Acres	37	60	65	65
percent of Refuge wetlands	1.2%	2.0%	2.2%	2.2%
Waterfowl Hunting Area				
Acres	0	0	140+[c]	282+[c]
percent of Refuge wetlands			4.6%	9.4%
Off trail area	546	0	0	0
	18.2%			

Note: Acres and percentages are not additive since there is overlap between facility types.

[a] trails, EE sites, viewpoints, and waterfowl hunting areas

[b] An additional site is proposed but a location has not yet been determined.

[C] As lands are acquired new hunting areas may be opened after review

view of 56 acres of several important wetlands (Overpass and Railroad Ponds, Wetland 90, Long Lake, and Ballinger Lakes). If use of the trail increases as expected, birds will flush and move away from the trail, reducing their use of important breeding and foraging habitat. Several areas adjacent to the trail provide important waterfowl migration habitat in the spring and fall. Flocks of birds are more susceptible to disturbance because of their tendency to react as a group. Individuals that flush in response to human activities within 328 feet can illicit behavioral responses from individuals in the flock at much greater distances (Fox and Madsen 1997). Alternatives 2, 3, and 4 propose utilizing vegetation plantings to screen trail users, putting them out of view of the southern end of Long Lake. If screening does not work, an optional 0.7-mile bypass trail which would allow trail users to use a parallel route out of view of Long Lake could be established. The bypass could alleviate most of the disturbance problems associated with foot traffic on this very exposed portion of the Columbia Plateau Trail. Placement of a viewing blind that would allow observers to approach Long Lake undetected would also increase opportunities to view wildlife while minimizing disturbance.

Alternatives 3 and 4 propose an additional 4-mile connecting trail from the CPT to the Public Use Area. Its course along the old Cheney-Plaza Highway would put individuals on foot and bicycle near several wetlands including the Overpass Pond, East Tritt Lake and Reeves Lake. Depending on the level of use and compliance to regulations restricting off-trail use, some impact to wildlife using these wetlands would be expected. In Alternative 4, the potential exists to add additional trails if land adjacent to the existing Public Use Area is acquired from a willing seller. Although placement of new trails would be made to minimize disturbance to wetland wildlife, some increased negative effects to wetlands and associated wildlife would be expected.

Viewpoints: Ten new viewpoints/pullouts were constructed in 2003 along the Pine Creek Auto-Tour Route, bringing the Refuge total to 19. Although five of these sites are in view of wetlands, only two are close enough to cause disturbance if individuals exit their vehicles. At these sites, appropriate signing will inform the public of the importance of staying in the vehicle. Any interpretative panels will be designed to be easily read from a vehicle. Under Alternatives 2, 3, and 4, two elevated viewing platforms (Upper Turnbull Slough and Stubblefield Lake) are proposed. Although both viewpoints would be within 328 feet of wetlands, the elevated platforms would focus the activities of wildlife observers and minimize disturbance to wetland wildlife. An elevated platform is also proposed at McDowell Lake under Alternatives 3 and 4.

Under Alternatives 3 and 4, the total number of viewpoints would rise from 19 to 25. Only the elevated platforms mentioned above and the viewpoint proposed for Cheever Lake would be placed within 328 feet of a wetland. The Cheever Lake location is elevated above the lake resulting in little expected human disturbance to wetland wildlife.

Photo Blinds: With only one blind in place and no restrictions on off-trail use under Alternative 1, disturbance from photographers attempting close approaches would likely increase as visitation increases. Public education that informs photographers of ethical and least intrusive methods is proposed under all alternatives and could reduce some impacts. Three new photo blinds are proposed in Alternatives 2, 3, and 4. All of the blinds would be accessible to persons with disabilities. The purpose of these photo blinds is to provide sites where photographers can get close-up photographs without disturbing wildlife. Placement of these additional blinds would likely reduce disturbance from wildlife photographers.

Environmental Education Sites: Although the infrastructure planned at the Environmental Education (EE) sites (parking and vault toilets at each site for all alternatives; shelters at each site for Alternatives 2, 3, and 4) are within 328 feet of wetlands, they would be located out-of-sight of adjacent wetlands to minimize disturbance to wildlife or direct impacts to wetland habitat. The aquatic study component of the spring and summer programs, however, places students at the wetland edge where they dip net for aquatic invertebrates. This concentrated use results in trampled vegetation along approximately 66 feet of shoreline as well as disturbance to waterfowl. An unpublished study (Jose 1997) examined the effect of EE site activities on the Turnbull NWR at Blackhorse Lake. The study results indicated that significantly fewer waterfowl were present in the study area when EE classes were on-site as compared to the control times. The study also found significantly more short flights undertaken by birds when EE classes were on-site. All alternatives include having one of the EE sites in rest/rotation at all times, resulting in a given site being used on only four days per week to minimize impacts to waterfowl and other wildlife. Under Alternatives 2, 3, and 4, hardening of the aquatic study sites and construction of a pier would focus use and minimize impacts to wetland habitat. If needed, under these alternatives, an additional EE site would be constructed. Although the location of the site has not been determined, it would have a similar configuration as the other sites. The presence of an additional aquatic study site would potentially increase the disturbance to wetland wildlife.

Office and Visitor Contact Point: No impacts would be expected from the Refuge Office/Visitor Contact Point or the EE classroom addition proposed under Alternative 2 since both are currently sited well away from wetlands. Under Alternatives 3 and 4, a new Refuge office and Visitor Contact Point may be constructed or leased. Siting of these facilities has yet to be determined. If the existing Headquarters area is used, then little impact to the effectiveness of wetland habitat for wildlife would be expected. Any new site selected would place facilities so that human activity is not regularly visible to wildlife on wetlands within 328 feet of the facility.

Elk Hunting: Elk hunting under Alternatives 2, 3, and 4 would cause some disturbance to waterfowl and other birds, associated with hunters walking in close proximity to wetlands and gunfire, which generally results in a behavioral response by birds. Elk hunting by its nature involves free roaming on foot throughout a hunting unit. Any portion of the Refuge that may be open to hunting will include wetlands. Waterfowl use, however, occurs only on the permanent and semi-permanent wetlands of the Refuge through mid-November, when freeze up usually occurs and waterfowl move to rivers and larger, deeper lakes off-Refuge. With a limited-entry permit hunt and generally a two-week period of overlap between the elk hunting season and the time period waterfowl numbers are normally present on the Refuge, impacts would be minimal. Potential expansion of the elk hunting areas into new acquisitions could occur under Alternatives 3 and 4 and could increase the level of disturbance relative to the other alternatives. The small number of hunters and infrequent gunfire would still result in only minimal impacts to waterfowl and other wetland dependent wildlife.

Waterfowl Hunting: Only Alternative 3 and 4 would have effects to wetlands and associated wildlife from waterfowl hunting since no waterfowl hunting is proposed under Alternatives 1 and 2. There are 140 acres of wetlands representing 17.5 percent of the Refuge's total fall wetland base included in the proposed hunting area (Upper Turnbull Slough) under Alternative 3. Approximately 35 percent of the fall wetland base would be open to waterfowl hunting under Alternative 4.

Waterfowl hunting results in direct mortality and crippling, and displaces waterfowl from foraging habitat during the fall migration period (Delong 2002). Bélanger and Bédard (1995) conclude that disturbance caused by waterfowl hunting can: a) modify the distribution and use of various habitats by birds (Owens 1977, White-Robinson 1982, Madsen 1985); b) affect their activity budget and reduce their foraging time and consequently their ability to store fat reserves necessary both for migration and breeding (Raveling 1979; Thomas 1983); and c) disrupt pair and family bonds and contribute to increased hunting mortality. Minimizing the number of days of the week the Refuge is open to hunting as well as the number of permits available to hunters, and using spaced blinds would restrict impacts to the defined hunt areas. Potential expansion of waterfowl hunting onto new additions would increase disturbance to waterfowl if this activity is currently not allowed.

Cumulative Public Use Impacts: Cumulatively, the public use program of Alternative 4 would have the greatest impact on the effectiveness of wetland habitat for wildlife. Although off-trail use within the Public Use Area would be seasonally restricted, proposed annual, season-long waterfowl hunting would increase disturbance as would the trails, viewpoints, and EE site additions and the potential expansion of the public use facilities onto new acquisitions. Alternative 3 would have less impacts than Alternative 4 because only a two day youth waterfowl hunt is proposed on approximately half the area identified in Alternative 4. The additional public use facilities, including trails, viewpoints, and EE sites, would be the same as in Alternative 4 and would contribute to disturbance of wetland habitat and wildlife. Alternative 2 would have less negative impacts than Alternative 3 because fewer trail, viewpoint, and EE site additions are proposed and the Refuge would remain closed to waterfowl hunting. Although Alternative 2 would have two new viewpoints, it would also have less negative impacts than Alternative 1, as a result of restrictions placed on off-trail use, creation of a bypass trail for the Long Lake portion of The Columbia Plateau Trail, and the construction of three additional photo blinds.

4.1.3 INDICATOR 3 - EFFECTS TO STEPPE HABITATS AND ASSOCIATED WILDLIFE

Effects from land protection actions

The quality index (see Table 4-7) or value of a given tract of steppe habitat to wildlife and to maintaining biodiversity is dependent on the size

of the tract, the presence or absence of exotic plant and animal competitors, and adequate native grass cover. Most of the steppe associated bird species, including the grasshopper, savannah and vesper sparrows, require both grass and litter cover for nesting. Spalding's silene, a threatened plant species, is found in areas of intact steppe habitat with high native plant diversity.

Compared to other habitats such as wetlands, conversion of steppe areas to other land uses including agricultural, residential and commercial is relatively easy, both from a logistical and regulatory standpoint. There is a general lack of knowledge concerning steppe habitat and its value in its native state, consequently, steppe under private ownership has few protections. Steppe protection on private land under all alternatives, but especially Alternatives 1 and 2, will require a well designed outreach and education program to increase awareness of the value of this habitat and its endangered status, as well as informing landowners of the incentive and conservation programs that can be applied in these areas. The potential to influence land use on 4,350 acres and 8,250 acres of high and medium quality steppe habitat within the Stewardship Areas of Alternatives 1 and 2, respectively, may increase protection of this habitat. However, it is expected that properties will continue to be subdivided and developed to the maximum density allowed by county zoning and restrictions imposed by critical area ordinances. Alternative 2 is expected to be more successful than Alternative 1, because the addition of outreach staff and the greater acreage of high and medium quality steppe habitat increases the probability of finding willing landowners to participate in conservation programs. Both alternatives, however, are not expected to result in a net gain in protected steppe habitat because losses will continue on the remaining large unprotected areas. The addition of an acquisition program in Alternatives 3 and 4 would increase the effectiveness of restoration and protection efforts on 4,340 acres and 8,240 acres respectively, of high and medium quality steppe.

Acquisition would likely be the most important tool where steppe is in danger of being sub-divided and developed.

The land protection actions of Alternative 3 would stabilize or moderately increase the quantity of high quality steppe habitat at current levels and the associated wildlife populations by off-setting continued losses on the remaining 7,600 acres of unprotected steppe within the Stewardship Area. Alternative 4, with its 25,000 acre cap on acquisition, would provide greater

Table 4-7. *Acres of Steppe Habitat by Quality Index Contained within Alternative Stewardship Areas and Estimated Acres Potentially Protected or Restored*

	Alt 1	Alt 2	Alt 3	Alt 4
Stewardship Area				
High	4,256	6,502	6,502	6,502
Medium	2,124	3,776	3,776	3,776
Low	761	1,677	1,677	1,677
Total	*7,141*	*11,955*	*11,955*	*11,955*
Potential acres of steppe protected or restored*	370	740	4,340	8,240

* Product of the estimated total area protected or restored under each alternative (from Table 4.2) and the percent composition of steppe habitat in the Stewardship Area.

opportunity to protect steppe, resulting in an increase in the restored and protected habitat base. This substantially expanded base of high-quality steppe habitat will result in net increases in populations of native wildlife species as native grass and litter cover increases and native plant diversity is restored.

Effects from Elk Management Actions (Not including hunting)

No impacts would be expected.

Effects from public use actions

The threat to steppe habitat and steppe associated species imposed by public use activities results from either the alteration of habitat, or disturbance of wildlife associated with development and improvement of facilities and both on and off-trail foot travel. Numerous studies have found that bird abundance, species composition, and nest success are affected by the presence of people on foot. In the mixed-grass prairie ecosystem in Colorado, Miller et al. (1998) found that specialist species (western meadowlark, vesper sparrow, and grasshopper sparrows) were less common near heavily used recreational trails. Generalist species such as the American robin, brown-headed cowbird ,and black-billed magpie were less affected by trail use. They also found that birds were less likely to nest near trails within the grassland ecosystem and that nest predation was greater near trails. For the majority of species, they found impact was greatest within a 246-foot (75 meter) zone of influence.

Decreasing abundance of birds adjacent to trails may be related to effects on territorial establishment. Gutzwiller et al. (1994) reported that even a single pedestrian moving through a bird's territory was sufficient to reduce the occurrence and consistency of primary song. Reijnen and Foppen (1994) found that in areas where primary song was affected by disturbance, birds there appeared reluctant to establish nesting territories. Reluctance to establish territories could result in lower densities of breeding birds. Zande et al. (1984) reported a negative relationship between the intensity of recreation occurring on trails and breeding bird densities in 8 of 13 bird species. In order to compare the alternatives, the acreage of steppe habitat open to foot travel and within 246 feet of public facilities (trails, viewpoints, pullouts, and EE sites) was chosen to indicate the potential threat of public use activities to steppe wildlife (Table 4-8).

Under Alternative 1, off-trail use would continue to be allowed within the entire Public Use Area which includes 1,200 acres of steppe habitat. As a result, Alternative 1 would have the greatest potential impacts of all the alternatives to steppe habitat and associated wildlife. Alternatives 2, 3, and 4 prohibit off-trail foot travel which would restrict the direct impacts of public use activities on habitat to the foot print of the facilities and a small area around them, rather than the entire Public Use Area. Because of this prohibition on off-trail foot travel, Alternative 2 would be expected to have the fewest negative impacts to steppe despite the loss of small amounts of steppe used for pullouts, trails, and viewing platforms, and increasing disturbance to steppe wildlife on nearly 200 additional acres associated with use at these new facilities.

Overall, Alternatives 3 and 4 would have greater negative effects on steppe habitat and wildlife than Alternative 2, due to an additional trail, location of an additional EE site, four new viewpoints, and additions to the EE classroom. Direct losses from actual facility construction would be restricted to less than 0.1 percent of the Refuge's existing steppe habitat base. Potential public use developments on new acquisitions could impact additional steppe habitat. The impacts to steppe habitat would be similar for Alternatives 3 and 4 with the exception of a larger waterfowl hunting program in Alternative 4 that could result in impacts to steppe vegetation by foot travel within the hunting units. These impacts would be expected to be minimal because the use occurs during plant dormancy and hunter numbers would be small.

Table 4-8. *Acres of Steppe Habitat within 246 feet of Public Facilities[a] and the Percentage of the Refuge Steppe Habitat Base Potentially Impacted by Public Use*

Public Use Facility	Alt 1	Alt 2	Alt 3	Alt 4
Off -trail foot travel				
Acres of steppe habitat	1,200	0	0	0
Percent of Refuge steppe habitat	20%	0%	0%	0%
Trails				
Acres	454	653	757	757[b]
Percent of Refuge steppe habitat	7.5%	10.8%	12.5%	12.5%
EE sites				
Acres	18	18	18[c]	18[c]
Percent of Refuge steppe habitat	0.3%	0.3%	0.3%	0.3%
Viewpoints				
Acres	27	39	42	42[d]
Percent of Refuge steppe habitat	0.4%	0.6%	0.7%	0.7%

[a] Trails, EE sites, viewpoints, and off trail use areas

[b] New trails may be added if land is acquired adjacent to existing Public Use Area

[c] An additional site is proposed but a location has not yet been determined.

[d] New viewpoints may be established if good vistas become available on new acquisitions.

4.1.4 INDICATOR 4 - EFFECTS TO PONDEROSA PINE FOREST AND ASSOCIATED WILDLIFE

Effects from land protection actions

The principle threats to forested habitat around the Refuge are fragmentation as a result of sub-division and home development, and private forest management. Subdivision development tends to cut holes in or eliminate the ponderosa pine forest leaving a few isolated trees for landscaping. Most private forest owners emphasize removal of the largest trees for economic returns, leaving dense stands of young, pole-sized trees. They also tend to remove a greater proportion of the dead trees thereby reducing the number of large diameter snags that are recruited and retained in the landscape. Such stands do not provide the large-diameter snags favored by cavity-using wildlife, nor the more open forest conditions required by snag roosting bats, western bluebirds, flycatchers, and ground foraging bird species. A comparison of the opportunity to protect additional forested habits afforded by the alternatives and the estimated area restored and protected is provided in Table 4-9.

The tendency for forests in private ownership to be over-managed from the viewpoint of wildlife habitat can be altered, to a point, through outreach, education and financial and technical assistance programs as proposed in all the alternatives. The action alternatives 2, 3, and 4 would provide more opportunities than Alternative 1 to find landowners willing to practice voluntary protection and restoration, due to the inclusion of nearly twice the acreage of ponderosa pine forest in the Stewardship Area of the action alternatives (Table 4-9). Projected participation in these voluntary conservation programs is not expected to offset continued fragmentation of larger pine stands and loss of stands of mature pine on the remaining unprotected areas. Populations of forested dependent wildlife that require mature trees and snags, coarse woody debris and diverse native

understories are expected to decline under programs that emphasize voluntary conservation efforts only.

Full protection and restoration of a forest stand would be more likely to occur when landowners have an opportunity to willingly sell their economic interests to an organization managing for wildlife and biodiversity. The expanded Refuge boundary proposed in Alternatives 3 and 4 would provide the opportunity to acquire forested property from willing sellers. with Alternative 4 providing substantially more opportunities than Alternative 3 (see Table 4.9).

The estimated area restored and protected under Alternative 3 would not substantially increase the habitat base of high quality ponderosa pine forest since over 50 percent of the high and medium quality forest habitat will still be unprotected and will likely decline in habitat quality. Land protection actions under Alternative 4 are expected to increase the base of high quality ponderosa pine habitat by potentially restoring and protecting an area equal to all the high and medium pine stands in the Stewardship Area. These actions would more than off set any losses on the remaining unprotected land resulting in increasing populations of forest dependent wildlife especially those associated with open mature stands of pine.

Effects from elk management actions (Not including hunting)

Elk populations do not in general impact ponderosa pine communities because of their low preference for pine and the ability of most grasses and forbs to withstand grazing pressure. Under very high densities, elk damage can, however, occur. Overgrazing and trampling can result in loss of preferred forage species and soil damage resulting in increased erosion and the spread of less palatable exotic species on disturbed areas. The only impacts to pine forest observed on the Refuge to date have been in the tall shrub phase of the Ponderosa pine/snowberry association. In these areas, high use of blue elderberry, serviceberry, chokecherry, and spiraea has occurred, impacting growth form and reproduction.

Some form of elk management is proposed under alternatives 2, 3, and 4. Elk management actions that reduce populations or redistribute animals will affect the density of elk in a given area. Successfully reducing elk densities in these areas will minimize impacts to the pine understory. It is important to note that redistributing elk from areas of high density to areas providing relatively greater security without reductions in population size will only transfer impacts.

Table 4-9. *Acres of Ponderosa Pine Habitat Contained within Alternative Stewardship Areas, by Quality Index, and Estimated Acres Potentially Protected or Restored.*

	Alt 1	Alt 2	Alt 3	Alt 4
Acres in Stewardship Area				
High quality habitat	3,942	8,109	8,109	8,109
Medium quality habitat	3,640	6,669	6,669	6,669
Low quality habitat	2,594	5,312	5,312	5,312
Total	*10,176*	*20,090*	*20,090*	*20,090*
Acres of pine habitat potentially protected or restored*	629	1,258	7,378	14,008

*Product of the estimated total area protected or restored under each alternative (Table 4.2) and the percent composition of ponderosa pine habitat in the Stewardship Area.

Effects from public use activities

The open nature of ponderosa pine forest and the lack of a well developed shrub layer in most stands places most tree and snag breeding and foraging species well above public use activities on the ground. These species, using higher habitat strata, are less susceptible to direct loss of habitat or damage to nests or individuals. Most, however, are still susceptible to human disturbance. Larger bird species that nest in pine stands, including red-tailed hawks, great-horned owls, and osprey, are especially intolerant of individuals on foot within their nesting territories. Zande and Vos (1984) found that 10 of the 12 passerine breeding bird species studied in woodlots in the Netherlands exhibited lower numbers in groves where recreation use was more common. Recreation intensity values ranging between 0.4 to 15 visitors per acre resulted in decreased breeding bird densities (Zande and Vos 1984). Research by Cooke (1980) on several passerine species in wooded habitat indicated there is a mean distance at which human activity is tolerated. Disturbances taking place at less than a species' mean tolerance distance resulted in movement away from the disturbance. Eighty-two feet (25 meters) represents an average tolerance distance of several species in their study. Based on this work, the area of ponderosa habitat open to foot travel, and within 82 feet of either trails, EE sites, viewpoints, or pullouts, are used here as indicators to compare the potential affect of public uses on the suitability of forested habitat for breeding wildlife (Table 4-10).

Ponderosa pine forests also support wildlife species that dwell near or on the ground. These species could be affected by direct vegetation impacts associated with off-trail foot travel and construction of public use facilities that reduce litter, grass and low shrub cover required for nesting and security. The same 82-foot zone is used to indicate the potential for effects on this group as well.

A lack of seasonal restrictions on off-trail foot travel within the public use area, which includes 691 acres of ponderosa pine habitat, would result in Alternative 1 having the greatest potential impact to breeding wildlife within ponderosa pine habitat. This alternative, however, has the least amount of forested habitat near public use facilities where disturbance would be more intense. Although Alternatives 2, 3, and 4 have more acres of pine forest intersected by new trails, seasonal restrictions on off-trail use would greatly reduce overall effects of the public use program. Under all alternatives, off-trail use associated with proposed hunting programs would have minimal to no impact on ponderosa pine habitat or associated wildlife because the hunting programs would involve a small number of individuals and take place outside the breeding season. Public use developments on new acquisitions under Alternatives 3 and 4 could negatively impact additional pine habitat. The extent of this future development is unknown, but impacts would likely be offset by improvements in habitat and greater control on human activities.

4.1.5 INDICATOR 5 - EFFECTS TO FOREST CONNECTIVITY

Effects from land protection actions

There are two primary forested corridors that serve to link the Refuge to the more contiguous forest zones of northeastern Washington and northern Idaho. These corridors follow the ancient Ice Age flood tracts north to the Spokane River drainage. The northeast corridor roughly follows the Minnie and Marshall Creek drainages to Hangman Creek and the northwest corridor extends north on the west side of Cheney through the Medical Lake area to the Deep Creek Drainage. The principal threats to the integrity of these linkages are fragmentation of forested habitat within the corridors associated with subdivision development and the creation of barriers by roads and fences. Although recent zoning changes will reduce the potential development density in important landscape linkages, development of parcels subdivided prior to adoption of new zoning laws would still significantly reduce the effectiveness of these linkages.

Table 4-10. *Acres of Ponderosa Pine Habitat within 82 feet of Public Areas and the Percentage of the Refuge Pine Habitat Base Potentially Impacted by Public Use.*

Public Use Facility	Alt 1	Alt 2	Alt 3	Alt 4
Area open to off-trail foot travel (breeding season)				
Acres	691	0	0	0
Percent of Refuge pine habitat	11%			
Trails				
Acres	110	127	159	159+[a]
Percent of Refuge pine habitat	1.8%	2.0%	2.6%	2.6%+
EE sites				
Acres	0.4	0.4	0.4+[b]	0.4+[b]
Percent of Refuge pine habitat	<0.1%	<0.1%	<0.1%	<0.1%
Viewpoints				
Acres	2	2.7	3.1	3.1+[c]
Percent of Refuge pine habitat	<0.1%	<0.1%	<0.1%	<0.1%+

[a] New trails maybe added if land is acquired adjacent to existing Public Use Area

[b] An additional site is proposed but a location has yet to be determined.

[c] New viewpoints maybe established if good vistas become available on new acquisitions.

The proposed Stewardship Area for Alternative 1 encompasses a substantial portion of an important landscape linkage northeast of the Refuge which extends to Hangman Creek. Projected participation in voluntary conservation programs on private lands will not, however, significantly slow development. Continued sub-division of larger forested tracts north of the Refuge will result in fragmentation and erosion of forest connectivity. A greater portion of the northeast linkage and the linkages west and northwest of the Refuge are included in the Stewardship Areas for Alternatives 2, 3, and 4. Increased outreach and education efforts proposed under these three alternatives will slow the rate of sub-division by increasing participation in private land conservation programs, but forested corridors will still slowly decline over time. Using land acquisition as a protection tool in conjunction with private land initiatives, as proposed in Alternatives 3 and 4, will be more effective in protecting forest connectivity beyond private land conservation programs. Alternative 3 would allow maintenance of minimally effective linkages while the fee-title acquisition or purchase of conservation easements on up to 25,000 acres of strategically located forested parcels and improved management of these parcels under Alternative 4 would create fully effective linkages to other forested zones.

Effects from elk management actions (Not including hunting)

There are no anticipated impacts to forest connectivity from any of the elk management actions.

Effects from Public Use Actions

There are no anticipated impacts to forest connectivity from any of the public use actions.

4.1.6 INDICATOR 6 - EFFECTS TO ASPEN RIPARIAN HABITAT AND ASSOCIATED WILDLIFE

Effects from land protection actions

The area of aspen lost from historic times within the Study Area (Table 4-11) is likely equivalent

to the loss on the Refuge - 65 percent - or possibly more. This loss is the result of encroaching ponderosa pine, overbrowsing by livestock, and clearing to improve pasture. Pine encroachment is the result of past and current fire suppression efforts. Without forest management to thin pine and regenerate aspen near wetlands, pine will continue to dominate seral aspen communities. Where aspen clones have severely declined, planting may be needed to reestablish aspen stands. Simplification of habitat structure in aspen as a result of grazing, pruning, understory clearing, and firewood cutting is commonly seen, especially on small parcels where the entire property is treated as a yard or the stocking of hobby livestock is high. Loss of habitat structure through removal of understory shrubs, grasses, forbs, and snags reduces the suitability of this habitat for shrub and tree canopy nesters and cavity-using wildlife species. Reversing this trend requires protection of aspen from grazing and outreach and education efforts focusing on the values of unmanaged aspen stands.

In addition to the direct impacts to aspen habitat described above, human development in close proximity to aspen stands can reduce the effectiveness of habitat through direct impacts to wildlife species. Non-native competitors that utilize cavities for nesting, such as starlings and European house sparrows, are often attracted to farms and suburban yards. The brown-headed cowbird (which parasitizes the nests of songbirds) increases in population where livestock are present. Pets, especially cats, can have significant effects on native wildlife through direct mortality and harassment. Native predators such as skunks and raccoons are often attracted to human developments because of supplemental food supplies associated with pet food and refuse. Human activity alone can affect the behavior of wildlife. Whether changes in behavior are detrimental to individual wildlife species depends on the intensity of the disturbance and its duration. Reducing these threats requires minimizing development near aspen communities. Some of these impacts can be offset by increasing the area and density of aspen through protection and restoration efforts that improve habitat structure.

Alternatives 1 and 2 provide the opportunity to protect and improve 243 acres and 380 acres, respectively, of aspen-dominated habitat and to benefit associated wildlife through outreach and education strategies to promote participation in conservation programs. The proposed Stewardship Area of Alternative 1, however, fails to include several aggregations of aspen stands, hence limits Service involvement in their conservation. Landowner participation in voluntary conservation programs and partnership activities will have some impact on land conversion, but many large land holdings

Table 4-11. *Acres of Aspen Riparian Habitat within Alternative Stewardship Areas, by Quality Index and Estimated Acres Protected and Restored.*

	Alt 1	Alt 2	Alt 3	Alt 4
Stewardship Area				
High quality habitat	182	271	271	271
Medium quality habitat	51	92	92	92
Low quality habitat	10	17	17	17
Total Aspen Riparian Habitat acres	243	380	380	380
Estimated Acres Protected and Restored*	12	24	144	274

*Product of the estimated total area protected and restored under each alternative (Table 4.2) and the percent composition of aspen riparian habitat in the Stewardship Area.

will continue to be sub-divided and developed resulting in an overall decline in the biological integrity of aspen habitats in the Refuge vicinity. Under Alternative 2, improved outreach and a larger Stewardship Area, which includes the highest quality aspen habitat in the Refuge vicinity, will reduce losses from sub-division and development, but land clearing and fragmentation will continue to occur on the remaining unprotected areas resulting in an overall decline. An expanded Refuge boundary in Alternatives 3 and 4 would increase the probability that additional aspen riparian habitat would be protected and managed for associated wildlife species over Alternatives 1 and 2 (Table 4-11). With the largest proposed acquisition encompassing 274 acres of aspen riparian habitat, Alternative 4 would afford the greatest opportunity to protect and restore additional riparian habitat thereby increasing the area and quality of aspen habitat and the populations of associated wildlife that breed and forage within the deciduous tree and shrub canopies (e.g. red-naped sapsucker, willow flycatcher, yellow warbler, and ruffed grouse).

Effects from elk management actions (Not including hunting)

Elk use and preference for aspen and other deciduous browse is well documented (Debyle 1985). Under high elk densities and limited habitat, elk browsing can have a significant negative impact on the regeneration of aspen and other deciduous trees and shrubs. Elk browse the tips of new shoots below about eight feet and also eat the bark of mature aspen. When browsing intensity is high enough to remove the majority of the current years growth, aspen will develop a shrub form or the new sprout will be killed. Without recruitment of an adequate density of well formed aspen stems, mature trees that die will not be replaced and the stand will decline. Without browsing, aspen sprouts can generally reach a height of eight feet within eight years putting them out of the reach of elk. Elk management that either reduces elk densities in an area during the winter by removal or redistribution can decrease browsing intensity enough to allow escapement and height growth putting them beyond the reach of elk .

The opportunity to employ elk management techniques to reduce elk densities under all alternatives will likely decrease impacts to aspen stands within the previous high elk use areas on the Refuge.

Effects from public use activities

Potential impacts of public uses on aspen habitat and associated wildlife include: changes to the habitat structure through construction of public use facilities; increased disturbance to wildlife from activities occurring in close proximity to riparian areas; and potential redistribution of elk and their browse impacts by hunting. None of the alternatives contain plans for the construction or improvement of public use facilities that would directly impact a significant area of aspen habitat. Proposed facilities would, however, place visitors in close proximity to aspen, resulting in disturbance to wildlife.

Songbirds and woodpeckers are the primary species groups potentially affected by public use activities in aspen riparian zones. Disturbance to birds by visitors, particularly those on foot, can result in behavioral responses and habitat impacts as previously described for wetland, steppe, and pine forests. Table 4-12 provides a comparison of the area of aspen within 82 feet (25 meters) of trails and EE sites and the percentage this area represents of the total Refuge aspen habitat. Eighty-two feet was chosen because it represents an average tolerance distance of thirteen passerines species in woodland habitat (Cooke 1980). Trails were chosen as a focal area, because individuals on foot have been shown to have the greatest potential to disturb wildlife. EE sites were also chosen as a focal point of disturbance because of the large number of students at these sites at one time and the duration of the activity. Alternative 1 would potentially have the greatest impact on aspen riparian habitat as a result of unrestricted off-trail foot travel in the public use area. Aspen stands are highly desirable locations for bird watchers and photographers because of the abundance and diversity of wildlife typically

Table 4-12. *Acres of Aspen Habitat within 82 feet of Trails and EE Sites and the Percentage of the Refuge Aspen Habitat Base Potentially Impacted*

Public Use Activity	Alt 1	Alt 2	Alt 3	Alt 4
Off-trail foot travel				
Acres	152	0	0	0
Percent of Refuge aspen	19%	0	0	0
Trails				
Acres	25	27	29	29
Percent of Refuge aspen	3%	3%	4%	4%
EE sites				
Acres	1	1	1+[a]	1+[a]
Percent of Refuge aspen	0.1%	0.1%	0.1%	0.1%

found there. There are approximately 152 acres of aspen/riparian habitat within the Public Use Area that could be affected under Alternative 1, representing 19 percent of the Refuge aspen habitat base.

The predicted increase in visitor use on the Refuge could have a significant impact on aspen-dependent wildlife. Public use activities under Alternative 2 would have the least amount of impact on aspen habitat and wildlife, primarily as a result of restrictions on off-trail foot travel and the moderate increases in trails and facilities. Impacts to aspen habitat and wildlife under Alternatives 3 and 4 would be similar and slightly higher than Alternative 2 as a result of additional trails and viewpoints. If public use is extended on to any new acquisitions (which could occur under Alternatives 3 and 4) some additional impacts may result. These effects may be mitigated by habitat protection and restoration efforts and proper placement of trails and new facilities that maintain adequate buffers.

Annual hunting, if allowed in the same area each year, may cause elk to begin using the remaining no-shooting zones, especially the Public Use Area, to a greater degree. This portion of the Refuge has historically received low elk use due to the relatively greater level of human disturbance. Aspen in this area has shown little impact from elk and regeneration typically reaches a height of eight feet within seven to eight years.

Since disturbance associated with hunting has a greater influence on elk behavior than other public uses (Skovlin 1982), elk will likely begin to habituate to the level of non-hunting related human disturbance in the no-shooting areas (Ward 1973). Increased density of elk in these no-shooting areas may occur under any of the alternatives including an elk hunt (Alternatives 2, 3, and 4) and may increase the intensity of aspen browsing in the no-shooting areas, off-setting gains made in the hunting zones. The potential to acquire additional lands under Alternatives 3 and 4 increases the opportunities to vary hunt units both temporally and spatially, to minimize problems with elk overuse of no shooting zones.

4.1.7 INDICATOR 7 - EFFECTS TO THREATENED SPECIES

Effects from land protection actions

Water Howellia: Identified threats to water howellia include: competition from exotic species, changes in the water regime of wetlands through draining or flooding, grazing, increased sedimentation from erosion, and ground disturbing activity within wetlands that could

disrupt the seed bed. With 33 occurrences, the Refuge supports one of the larger metapopulations of this species within its range. This metapopulation, however, extends beyond the Refuge boundary. Hundreds of wetlands around the Refuge have the potential to provide habitat for water howellia (Table 4-13). If these wetlands do support populations of water howellia, then the Stewardship Area private land conservation programs may help minimize threats. Securing their future existence would conserve the metapopulation of the species and reduce the risk of extinction.

Protection of water howellia populations on private land would require minimizing the threats enumerated above. Minimizing land development for either domestic or commercial use would have the greatest benefit for this species and its habitat.

Spalding's Silene: Spalding's silene is a perennial plant species found in areas of high quality intact steppe of eastern Washington and Oregon. Six occurrences have been located on the mounded soils of the Refuge. Potential threats to this species are the same as those impacting steppe. The difference between alternatives is primarily based on the amount of high quality steppe habitat that would potentially be protected (Table 4-13). The effectiveness of the alternative protection strategies is the same as those described for steppe habitat.

Bald Eagle: Bald eagle fall and winter use is limited in the Refuge vicinity primarily by the shortage of large, permanent wetlands that host concentrations of waterfowl, their principal winter food. The relatively high level of disturbance associated with human activity around existing eagle habitat off-Refuge may also contribute to low use in this area.

Although opportunities to protect existing fall and winter habitat exist within the protection areas identified in the alternatives (Table 4-13), the greatest positive impact to eagles would be

Table 4-13. *Habitat Area for Threatened and Endangered Species Affected*

	Alt 1	Alt 2	Alt 3	Alt 4
Water howellia habitat				
Stewardship Area				
Number of wetlands	200	400	400	400
Acres of howellia habitat	454	885	885	885
Estimated Acres Protected and Restored [a]	38	82	350	640
Spalding's silene habitat				
Acres of habitat in Stewardship Area	4,256	6,502	6,502	6,502
Estimated Acres Protected and Restored [b]	358	605	2,575	4,700
Fall/winter bald eagle habitat				
Acres of habitat in Stewardship Area	118	351	351	351
Estimated Acres Protected and Restored [c]	104	208	890	1,624

[a] Product of the percent composition of howellia habitat in the alternative Stewardship Area and the estimated area protected and restored under each alternative

[b] Estimated area of high quality steppe protected under each alternative (Table 4.7)

[c] Estimated acres of permanent wetlands protected and restored under each alternative (Table 4.3).

the restoration of additional permanent wetlands and minimizing development and its associated human disturbance in these areas. Comparison of the alternatives in this regard is also provided in Section 4.1.2.

Effects from elk management actions (Not including hunting)

Water howellia: No impacts would be expected from non-hunting elk management activities. This work would not take place within wetlands.

Spalding's silene: No impacts would be expected as the area of steppe habitat impacted by any elk management activity would be very small and all known populations would be avoided.

Bald Eagle: There could be short term disturbance to bald eagles associated with capture activities if relocation is utilized. This activity would occur in a localized area and for a short period of time resulting in only minimal impact.

Effects from public use actions

Water howellia: No adverse impacts to populations of water howellia would be expected from public use activities proposed in any of the alternatives. No public use facilities are planned within or adjacent to wetlands with known occurrences of water howellia.

Spalding's silene: Potential threats to Spalding's silene include direct impact to populations and habitat associated with facilities expansion, trampling of vegetation by foot travel, and potential introduction of exotic species. Over the course of the next 15 years, visitation at the Refuge is expected to increase. There are six known populations of Spalding's silene within the Public Use Area. A lack of restrictions on off-trail use in the Public Use Area under Alternative 1 may result in some impact to Spalding's silene as well as the possible introduction of exotic plant competitors. None of the alternatives, however, have proposed facilities near any known populations of this plant species on the Refuge. The minimal impact that alternative facilities development would have on steppe habitat makes any impact to this plant species unlikely.

Bald Eagle: Bald eagles could potentially be affected by disturbance associated with Refuge visitors engaged in wildlife observation, bird watching, photography, and environmental education under each of the four alternatives. Wintering populations of bald eagles have shown susceptibility to disturbance resulting in disrupted foraging behavior and changes in social dynamics between other species in the avian scavenger guild (Skagen et al. 1991) and avoidance of areas with high disturbance (Stalmaster and Newman 1978). Stalmaster and Newman (1978) also found that recreational activities occurring within 820 feet (250 meters) of roosting and foraging areas resulted in changes in distribution patterns by displacement to areas of lower human activity. Under all alternatives, trails and public use facilities would occur within 820 feet of bald eagle foraging habitat within the Public Use Area as well as along the Columbia Plateau Trail (Table 4-14). Under all the alternatives visitation to the Refuge is expected to increase. The lack of adequate controls on public use activity under Alternative 1 would likely result in significant impacts to bald eagles in the Public Use Area and adjacent to the Columbia Plateau Trail. The three action alternatives have greater restrictions on public use activities, but increase the number of facilities and access into areas that are currently closed. In general, adverse effects to eagles would likely increase from Alternative 2 to 4, as additional trails and facilities are developed. The impact this increase will have on bald eagles depends on the extent the design of public use facilities takes into account wildlife and habitat needs.

The potential for a limited-entry elk hunt in Alternatives 2 through 4 could result in short-term impacts to eagle use within the hunt units. Hunt units would incorporate portions of the large permanent wetlands utilized by eagles, and hunters would occasionally be walking within 820 feet of this habitat. Stalmaster and Newman

Table 4-14. *Acres of Bald Eagle Fall/Winter Habitat Potentially Affected by Off-Trail Foot Travel, within 820 feet of Public Areas* and the Percentage of the Refuge Bald Eagle Habitat Base Potentially Impacted by Public Use Activities.*

Public Use Facility	Alt 1	Alt 2	Alt 3	Alt 4
Off trail foot travel - acres Percent of Refuge eagle habitat	170 17%	0	0	0
Trails Acres Percent of Refuge eagle habitat	 177 18%	 198 20%	 222+[a] 22%+	 222+[a] 22%+
Viewpoints Acres Percent of Refuge eagle habitat	 81 8%	 107 11%	 134+[b] 13.8%+	 134+[b] 13.8%
Waterfowl Hunting Percent of Refuge habitat			140+[c] 14%+	282+[c] 28%+
Total Acres Potentially affected Percent of Refuge habitat	180 18%	219 22%	383+ 40%	525+ 54%

* Trails, viewpoints and waterfowl hunting areas

[a] New trails maybe added if land is acquired adjacent to existing Public Use Area

[b] New viewpoints maybe established if good vistas become available on new acquisitions.

[C] Additional waterfowl hunting areas may be established on new acquisitions following a review

(1978) found that gunshots were the only noises that elicited overt escape behavior by bald eagles in their study. Edwards (1969) also found that gunshots could be used to flush eagles from their roost (cited in Stalmaster and Newman 1978). The small number of elk hunting permits issued and the short period of time hunters would be present near bald eagle habitat would result in only minor impacts to eagles under all alternatives. Varying hunt units spatially and temporally may reduce some of these impacts.

Annual waterfowl hunting as proposed under Alternative 3 and 4 would increase the amount of disturbance to bald eagles within hunt units resulting in avoidance of these areas. The two - day youth waterfowl hunt as proposed in Alternative 3 would, however, have negligible impacts on bald eagles. The larger season-long waterfowl hunt proposed in Alternative 4 would impact a significant portion of the available bald eagle habitat on the Refuge.

Waterfowl hunting may, however, increase the food base as a result of wounding and crippling of waterfowl. Under Alternative 4, limiting the number of days per week open to hunting and restricting shooting hours could potentially increase eagle use of the hunting units.

All of the existing and restorable fall /winter bald eagle habitat off-Refuge receives human use that could potentially be affecting roosting and foraging bald eagles. If some of this habitat is acquired as proposed under Alternatives 3 and 4, some public use may be allowed. The impact this use will have on bald eagles depends on the extent to which bald eagle needs are considered in the design of public use facilities. Control of human access may actually reduce disturbance and increase bald eagle use.

4.2 SOCIAL EFFECTS

4.2.1 OVERVIEW /GENERAL

As an overview to assessing the social effects of Alternatives 1 through 4, it is important to understand the broader context of Turnbull NWR within the region and how recreational demand and public use is expected to change over time.

A growing visitor presence in the Refuge area can be expected in the future, based on IAC estimates provided in Chapter 3. Many of the public use opportunities currently provided at the Refuge – hiking, outdoor photography, sightseeing and exploring, nature study, and wildlife observation – are very popular within the State and are forecasted to attract increasing amounts of participants in the coming years. The newly developed Columbia Plateau Trail will also play a role in increasing Refuge visitation. Since a large proportion of current visitors to the Refuge are from Spokane County, it is also important to consider the significant amount of population growth forecast for the county. Based on these factors, non-school related public use at the Refuge, particularly the auto tour route area, will increase in the future. This will occur no matter which alternative is selected.

Table 4-15 shows Refuge visitation (number of Refuge visits, annually) estimates for several categories, both currently and expected under the different alternatives. The following background information may be useful in interpreting this table. Current visitation refers to the Refuge's best estimate of annual visitation in year 2003. It is based on Refuge Management Information System (RMIS) data from the three to five years preceding 2003, as presented in Chapter 3, but is not always an exact average of these numbers.

The numbers shown for Alternatives 1, 2, 3, and 4 represent the Refuge's best estimate of the number of visits in each category *during the final year of the 15-year CCP time frame* (i.e.

Table 4-15. *Annual Refuge Visitation, Projected in 15 years, by Alternative**

Recreation Category	Current Visitation	Alt 1	Alt 2	Alt 3	Alt 4
Wildlife observation[a]	20,000	26,500	29,500	32,500	35,500
Wildlife / nature photography[b]	4,000	5,000	6,000	6,500	7,000
Hiking / Foot Trail use	12,000	14,000	14,500	17,000	20,000
Bicycling[c]	1,000	1,250	1,250	3,750	5,000
Visitor Center	6,000	7,500	10,000	15,000	21,000
Environmental Education[d]	5,000	5,000	6,000	9,000	10,000
Waterfowl hunting	0	0	0	15	450
Elk hunting	0	0	80	80	80

* Refuge visits are not totaled since visitors may engage in more than one activity per visit.

[a] Not counting EE program

[b] Hobby photographers account for a majority of this category

[c] Not including bicycle use on Columbia Plateau Trail

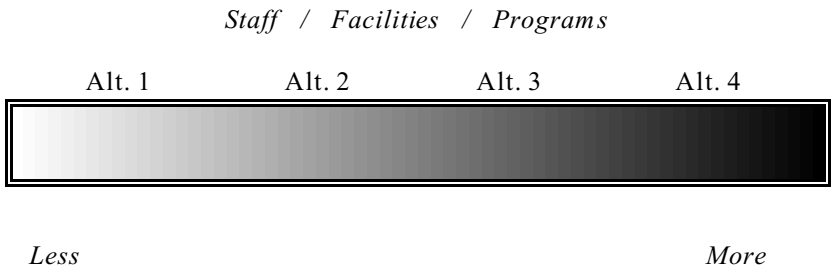
[d] On-Refuge environmental education only

during year 2020 if the Refuge signs its CCP in 2005). The future visit numbers are estimates based partly on the projections provided by IAC (2002b) for changing visits in different outdoor recreation categories over the next two decades. Facilities and programs that would be part of each alternative also figured into the estimate.

Note that although significant quantities of land could be added to the Refuge under Alternatives 3 and 4, with consequent increases in the area available for recreation, this potential increase was not factored into the numbers presented for these alternatives. The reason for this is that the exact location and timing of land acquisition cannot be predicted. Therefore, the numbers for Table 4-15 simply represent the visits expected within the current Refuge fee title ownership, by alternative.

Refuge services provided to support recreational visitors would differ along a continuum, depending on the alternative, with Alternative 1 providing existing, relatively low levels of staff, facilities, and programs. These increase by alternative, with Alternative 4 providing the highest level of staff, facilities, and programs.

Currently, the Refuge is an important public area, used mainly by county residents. Public use and recreational activities currently supported at the Refuge include watching and photographing wildlife, environmental education, hiking, and bicycling. These activities would continue under all alternatives, but Alternatives 3 and 4 would be better able to accommodate increasing demand for these activities because of enhanced public use facilities and programs. In addition, under Alternatives 3 and 4, the Refuge's attraction to other potential visitor groups would be expanded as a result of enhanced or new public use facilities and expanded trail opportunities.



The Public Use Area remains the same under Alternative 1, but is enlarged under Alternatives 2, 3, and 4 to accommodate additional trails. Public use at the Refuge would continue to be day use only in all alternatives. Under Alternative 1, off trail use would be permissible, but off trail use would not be allowed under Alternatives 2, 3, or 4. Certain non-wildlife dependent uses would continue to be prohibited.

Greater accessibility to persons of all abilities would be available at increasing levels from Alternative 1 through Alternative 4. All alternatives would fix or replace the existing wheelchair-accessible Boardwalk while Alternatives 2, 3, and 4 also include the wheelchair-accessible Kepple Peninsula and Pine Lake Loop trails. All alternative actions provide ADA-accessible opportunities.

Fishing opportunities are available in the county and in the Refuge vicinity at the many surrounding lakes and rivers. Fishing is not a viable activity at Refuge lakes due to the lack of a stable fishery and other fishery and wildlife habitat constraints. As a result, fishing was not an activity that was considered during the CCP planning process.

4.2.2 INDICATOR 1 - OPPORTUNITIES FOR COMPATIBLE NATURE/WILDLIFE OBSERVATION AND BIRD WATCHING

Effects from Land Protection Actions

Alternatives 2, 3, and 4 include a large 44,356-acre Stewardship area around the Refuge (in Alternative 1, the Stewardship Area would be the priority areas designated in the approved HMP - approximately 21, 396 acres). Within the Stewardship Area, the Refuge would encourage greater conservation practices and restoration from interested private landowners. If these conservation and restoration activities were to be undertaken, there could be an indirect effect of increasing the quality of wildlife observation and bird watching on the Refuge and within the Refuge vicinity.

Alternatives 1 and 2 keep the Approved Refuge Boundary the same and under these alternatives there are no significant opportunities for the Refuge to expand designated wildlife observation areas outside the Refuge. Alternatives 3 and 4 expand the Approved Refuge Boundary, and contingent upon the availability of willing sellers, provide opportunities for protection of up to 12,000 acres (Alt 3) or 25,000 acres (Alt 4) under the National Wildlife Refuge System. Under these alternatives, lands could be acquired from willing sellers within this expanded area and there is the potential that additional designated wildlife observation areas could be added in the future.

Effects from Elk Management Actions (Not including hunting)

Elk management actions would be similar across all alternatives. Overall, all of the elk management actions are aimed at reducing the elk population. Elk management actions could result in a decrease in elk sightings over time. Non-hunting methods should not affect sightings of any other animals.

Effects from Public Use Actions

Wildlife observation and wildlife photography would be supported in all alternatives, with Alternative 1 being the least intensive and Alternative 4 being the most intensive. In all four alternatives, this activity would occur in the Public Use Area and along the Columbia Plateau Trail. All alternative actions would continue to provide opportunities for nature/wildlife observation; however, Alternatives 3 and 4 would enhance opportunities for this activity the most by providing additional designated viewpoint areas, additional photo blinds, and more facilities.

Designated viewpoints (auto pull-off areas with possibly a short trail to a photo blind, scenic overlook or interpretive panel) are provided in all alternatives but vary in scope. Alternative 1 would provide 19 viewpoints while Alternative 2 would have two additional viewpoints and would provide more improvements (interpretive signs) at most sites. Alternatives 3 and 4 would provide 25 viewpoints each, and interpretive signs would be placed at most.

Photo opportunity blinds would be provided in all alternatives, but would vary by alternative. In Alternative 1, one blind would be provided (not accessible). In Alternatives 2 through 4, four photo blinds would be provided with three of them designed to be accessible.

Hunting could have a positive effect on wildlife observation quality. All hunt areas would be located outside the boundaries of the Public Use Area and buffered from the Columbia Plateau Trail and county roadways. No safety conflicts would be expected between hunters and non-hunters. Although it's difficult to predict with certainty, wildlife observation opportunities could be increased as a variety of animals move away from the hunted zones toward sanctuary areas, including the Public Use Area. The ultimate outcome for the visitor is that higher numbers of animals may be visible, but the aesthetic value of the experience may be diminished somewhat by the occasional sound of shots.

Alternatives 1 through 4 provide a varying level of facilities with Alternative 1 providing the least and Alternative 4 providing the most. Some of these facilities (i.e., interpretive exhibits at a visitor contact facility, additional hiking trails, interpretive signs, bike trail, and improvements along the Columbia Plateau Trail) may indirectly contribute to the quality of wildlife viewing available by helping visitors to better understand and enjoy what they see.

Alternatives 3 and 4 include a provision to cooperate with WSPRC, should they choose to add additional facilities along the Columbia Plateau Trail at the north border of the Refuge. These actions would encourage additional nature/wildlife observation along the Columbia Plateau Trail, particularly Alternatives 3 and 4.

Along the Columbia Plateau Trail, Alternatives 2, 3, and 4 would provide vegetative buffering (planting of hawthorne), additional visitor education, and potential seasonal closures along Long Lake. Ultimately these actions are aimed at protecting the wildlife habitat present at Long Lake and will contribute, over the long-term, to the quality of wildlife observation along the whole Refuge section of the Columbia Plateau Trail.

4.2.3 INDICATOR 2 - OPPORTUNITIES FOR COMPATIBLE NON-MOTORIZED TRAIL ACTIVITIES AND LONGER TRAIL LOOP OPTIONS

Effects from Land Protection Actions

No effects to trail opportunites are expected under Alternatives 1 and 2. Under Alternatives 3 and 4, the Refuge approved boundary would be expanded and, contingent upon the availability of willing sellers, additional lands would be added to the Refuge. If large, contiguous blocks are added, there may be a possibility to add additional Refuge trails in the future.

Effects from Elk Management Actions (Not including hunting)

No effect to trails from any of the non-hunting elk management actions is foreseen under any alternative.

Effects from Public Use Actions

All alternatives would provide non-motorized, multi-use trails; however, they would increase in number and length by alternative. Alternative 1 includes 11.5 miles of trails with 6.75 miles in the Public Use Area and 4.75 miles along the Columbia Plateau Trail with no trail longer than 1.5 mile. Alternative 2 would include 15.25 miles of trail with a new longer Stubblefield Trail loop. Alternatives 3 and 4 would also include 15.25 miles of trail, but additional trails may be added if lands are acquired in the future, including longer trail loops.

Under Alternative 1, the longest pedestrian only loop trail available to visitors is one mile. Alternatives 2, 3, and 4 would provide visitors with a pedestrian only loop trail of 5.3 miles. Were a visitor to start on a bicycle, the loop possibilities would be many miles longer under Alternative 3 and even longer with more diversity of scenery under Alternative 4.

Thus, all alternative actions would provide opportunities for trail use; however, Alternatives 2, 3 and 4 would further enhance this activity. All trailheads would be located in the Public Use Area (with the exception of trailheads for the Columbia Plateau Trail) and trail surfaces would vary by location.

Visitors using trails may have a more pleasing experience when encountering viewpoints, blinds, and/or interpretive material along the way. In general, these opportunities increase with each alternative, with Alternative 4 providing the highest number of viewpoints, blinds, and interpretive sites.

The Boardwalk and Kepple Peninsula Trail would be redeveloped as interpretive trails (multiple interpretive signs or markers) under all

alternatives. In Alternatives 2, 3, and 4, the Pine Lake Loop Trail with multiple interpretive signs would also be added.

Opportunities for ADA-accessible trail and access opportunities would vary by alternative. Each of the interpretive trails would be designed to be ADA-accessible. The existing Boardwalk would be fixed or replaced under all alternatives. Alternatives 2, 3, and 4 would also include accessible trail opportunities at the Kepple Peninsula and Pine Lake Loop trails.

In Alternative 3, a designated bike trail that connects the Columbia Plateau Trail with the Public Use Area would be provided. It would generally follow the old highway roadbed inside the Refuge. Alternative 4 would include this bike route and loop it through the Public Use Area, out Gate 19, and up Cheney-Spangle Highway to Cheney. The Refuge would partner with Spokane County Roads Department and other entities to seek funds and design assistance for the development of paved bike lanes and safe, marked access points where needed on the county highways.

Along the Columbia Plateau Trail, Alternatives 1 and 2 would provide a vault toilet and benches. Alternatives 3 and 4 would also provide sign-in books, additional benches, and cooperation with WSPRC, should they choose to provide additional parking, kiosk, and/or restroom facilities at another nearby trail location. Through these measures, Alternatives 3 and 4 would encourage additional trail use along the Columbia Plateau Trail.

At Long Lake, a new 0.7- mile bypass trail along the Columbia Plateau Trail could possibly be provided in Alternatives 2, 3 and 4. If constructed, this action would allow trail users to detour off the Columbia Plateau Trail and follow a 1-mile long trail through a natural environment within the Refuge. In addition, Alternatives 2 through 4 would help minimize disturbance from trail users in the Long Lake area or other sensitive locations. This would be accomplished through the use of vegetative buffer plantings (hawthorne), increased visitor education, and potential seasonal closures or trail re-routes inside the Refuge. Alternatives 2, 3, and 4 with tall thorny vegetative screening and the potential for seasonal trail closures may negatively effect wildlife observation opportunities in the Long Lake area.

Hunt programs established under Alternatives 2, 3, and 4 would not have any significant impact on trail opportunities. Hunt areas would be located well away from trails and there should be no safety conflicts.

4.2.4 INDICATOR 3 - OPPORTUNITIES FOR INCREASING NUMBERS OF "DESTINATION" VISITORS

Small or moderately sized natural areas without overnight use can find it hard to attract "destination" visitors. Destination visitors are typically residents from other areas, and as such, would rely more heavily on local restaurants, hotels and other tourist support businesses than visitors who reside within the local area. As such, destination-oriented visitors can be positive for the local economy. Being known as a destination stop also helps put a Refuge "on the map" with regard to internal agency recognition and support, with likely increases in funding to support Refuge programs.

Effects from Land Protection Actions

Alternatives 1 and 2 keep the Approved Refuge Boundary the same. Under Alternatives 3 and 4, the Refuge's approved boundary would be expanded, and contingent upon the availability of willing sellers, additional lands would be added to the Refuge. The potential for a larger Refuge under Alternatives 3 and 4 may eventually result in an increase in the number or length of trails or viewpoints available to visitors. Such an increase would increase the complexity of recreational opportunities available at the Refuge, making the Refuge more likely to be a destination stop for visitors from outside the local area.

All alternatives also include a Stewardship Area, which would rely on partnerships and voluntary

means to improve wildlife habitat. Enhanced wildlife habitat could result from Stewardship Area activities, which could improve viewing opportunities all around the Refuge, possibly increasing the areas's reputation as a "destination" spot.

Effects from Elk Management Actions (Not including hunting)

Non-hunting elk management actions would be similar across all alternatives. Overall, all of the elk management actions are aimed at reducing the elk population. The employment of non-hunting elk management actions would be more likely under Alternatives 1 than the other alternatives, and could decrease the chance of attracting more destination visitors to the Refuge.

Effects from Public Use Actions

There are several factors that could increase Turnbull's visibility as a destination stop for visitors. One would be the availability of blinds and viewpoints that increase a visitor's chances of seeing rare birds or birds engaging in interesting behavior (i.e. a colonial nesting site). Another would be longer, loop trails and trails meandering through a diversity of habitats. A third would be a well-built and designed EE and interpretive center. An opportunity for uncrowded, high quality hunting would be a fourth factor for attracting destination visitors. Outreach and signs posted in key places, such as along Interstate 90, could also be instrumental in increasing destination tourism, independent of wildlife and habitat conditions. There are other factors that attract destination visitors that cannot be controlled (such as a posting of a Rare Bird Alert).

Based on factors that can be controlled, Alternative 4 would most likely provide the conditions that would attract destination visitors and Alternative 1 would be the least likely to provide these conditions. Alternatives 2 and 3 would be intermediate.

4.2.5 INDICATOR 4 - OPPORTUNITIES FOR QUALITY HUNTING

Effects from Land Protection Actions

Hunting does not occur on Refuge currently but does occur on neighboring private lands. All alternatives promote voluntary conservation within a Stewardship Area around the Refuge. To the extent that conservation actions may expand habitat or sanctuary for game animals, there could be an increase in the quality of hunting available off-Refuge under all Alternatives, with the greatest quality potentially available under Alternative 4 and the least under Alternative 1. Similarly, conservation actions can affect the quality of public hunting that will be available on-Refuge under Alternatives 2, 3, and 4. Quality public hunting on Refuge would be expected to be highest under Alternative 4, intermediate under Alternative 3, and low under Alternative 1.

Effects from Elk Management Actions (Not including hunting)

Non-hunting elk management actions would be similar across all alternatives. Overall, all of the elk management actions are aimed at reducing the elk population. As such, if these were used in conjunction with an elk hunt in any particular alternative, the hunt quality could go down as there could be fewer elk at which to shoot.

Effects from Public Use Actions

Future demand for hunting is expected to decrease slightly in the coming years. However, as the overall county and the Cheney area continues to grow in population, some existing private hunting areas will no doubt be lost to new development over time. Under Alternatives 2, 3 and 4, elk hunting would occur annually on approximately 5,230 acres that are not open to other public uses. The number of permits and seasons opened would vary depending on the level of habitat damage (mainly to aspen). Alternative 3 provides for an annual youth waterfowl hunt on Upper Turnbull Slough. Alternative 4 also provides for fall

waterfowl hunting at Turnbull Slough and West Tritt Lake. In Alternatives 2, 3, and 4, the Refuge would potentially provide a turkey hunt depending upon turkey population trends.

All hunts that could occur would be designed as quality hunts, as defined in Chapter 2, Objectives 7L and 7M.

In sum, of the four alternatives, Alternative 4 provides the most opportunities for hunting on the Refuge. It is unknown if elk hunting quality would change over time under Alternatives 2, 3, or 4.

4.2.6 INDICATOR 5 - OPPORTUNITIES FOR A COMPATIBLE AND SUSTAINABLE ENVIRONMENTAL EDUCATION PROGRAM, BOTH ON-REFUGE AND OFF-REFUGE

Effects from Land Protection Actions

Within the Stewardship Area designated under all alternatives, the Refuge would encourage greater conservation practices and restoration from interested landowners. These activities could possibly form the basis of off-Refuge Environmental Education activities cosponsored by the Refuge and private landowners.

Under all alternatives, EE sites and facilities will be centered within the Public Use Area and would not be established on any additional lands added to the Refuge. .

Effects from Elk Management Actions (Not including hunting)

No effect to the EE program from non-hunting elk management activities was identified.

Effects from Public Use Actions

The Refuge continues to attract many school groups annually, who participate in the Refuge's EE program. This is a well established and successful program seeing increased demand as school districts continue to expand their EE curriculum while simultaneously accommodating more students due to population growth. Very few other nearby locations offer this same program or site opportunities (EDAW 1999). It appears that the Refuge could schedule as many school trips as it could reasonably accommodate, given sufficient funding. There is no shortage of demand for EE activities at the Refuge now, nor is demand expected to soften in the future.

All alternatives would provide for an on-Refuge EE program; however, the EE program would vary by alternative with Alternative 1 providing a lower level of EE services and facilities and Alternative 4 providing the highest level of EE services and facilities.

Similarly, all alternatives provide for an EE program off of the Refuge. The effect varies by alternative with Alternative 1 providing a lower level of off-Refuge EE programs and support and Alternative 4 providing the highest level of off-Refuge EE programs and support.

Refuge staff and facilities would vary under the alternatives in line with the level of service provided. Alternative 1 would provide the same staff and facilities as now. Existing base staff and facilities cannot adequately support the current demand for EE programs, hence there is a lot of fluctuation annually depending upon what kind of grant money has recently been obtained. Alternatives 2, 3, and 4 would all attempt to remedy this instability by providing higher annual base funding to support staff. In addition, Alternatives 3 and 4 would double the size of the EE facilities (a brand new facility would be built under Alternative 4). The actions to upgrade and expand staff and facilities in Alternatives 3 and 4 would most enhance the on-Refuge and off-Refuge EE programs and provide the greatest opportunity for the local and regional public to enjoy the benefits of environmental education.

Alternatives 2, 3, and 4 all accommodate some level of hunting on Refuge lands. New areas could be designated if additional lands were acquired. Under any alternative, if hunting were to be employed, safe hunting areas would be

designated away from the Public Use Area, county roads, and the Columbia Plateau Trail. No safety issues would be expected between hunters and non-hunters. There could be some disturbance which may cause animals to move around the Refuge and into the public use area or other non-hunted sanctuary areas on or off the Refuge. This would not have any significant impact on EE program activities.

4.2.6 INDICATOR 6 - OPPORTUNITIES FOR COMPATIBLE INTERPRETATION, BOTH SELF-GUIDED AND STAFF-LED

Effects from Land Protection Actions

No effects to interpretation opportunities are expected under any alternative.

Effects from Elk Management Actions (Not including hunting)

Elk management activities, which would be a new activity at the Refuge, would require their own interpretation emphasis. This would be most facilitated under the alternatives that provide a greater exhibit area and naturalist services (i.e., Alternatives 3 and 4).

No other direct effect to the interpretation program from elk management activities was identified. No safety issues would be expected under any alternative.

Effects from Public Use Actions

All alternative actions provide opportunities for interpretation; however, Alternatives 2, 3 and 4 would further enhance this activity by providing additional interpretive trails and signs, exhibits, and naturalist services.

Currently, the Refuge does not have any central interpretive area or staffed visitor contact / welcome facility that is linked to the auto tour route and could serve as a jumping-off point for Refuge visitors. This condition limits the use of the Refuge by those who are constrained by time or physical ability from exploring interpretive materials, nearby trails, and viewpoints directly.

Visitor welcome areas would vary by alternative. In Alternative 1, no new facility would be provided. In Alternatives 2, 3, and 4, four interpetive panels overlooking Winslow Pool would be provided. In Alternative 2, a small volunteer-staffed information point would help meet this need for visitor welcome as well as orientation to the Refuge environment. In Alternatives 3 and 4, additional staffed new or expanded facilities would be provided to help meet this growing need and to provide an enhanced experience for Refuge visitors, including new interpretive and orientation exhibits. Alternatives 2, 3, and 4 would provide a new gate and fee station closer to Cheney-Plaza Highway. This action would enhance visitor management and help avoid confusion for visitors.

Designated viewpoints (auto pull-off areas with possibly a short trail to a photo blind, scenic overlook or interpretive panel) would be provided in all alternatives but would vary in scope. Alternative 1 would have 19 viewpoints while Alternative 2 would have 21 viewpoints, most with more improvements, especially interpretive signs. Alternatives 3 and 4 would have the same 21 viewpoints, plus 4 more along county roadways (Upper Turnbull Slough, McDowell Lake, Helm Marsh, and Stubblefield/steppe habitat).

Interpretive trails with signs would be provided in all alternatives. These would include the Boardwalk (with signs) and Kepple Peninsula Trail (with trail markers and interpretive brochure). Under Alternatives 2, 3, and 4, the Pine Lake Loop Trail, with signs, would be added.

Provision of the services of an interpretive naturalist would vary by alternative. No naturalist would be provided in Alternative 1. Alternative 2 would include an occasional, volunteer naturalist. Alternatives 3 and 4 would offer a naturalist with scheduled programs.

Hunting would not occur under Alternative 1. Annual hunting would occur under Alternative 2, 3, and 4 for elk and possibly turkey.

Alternative 3 would provide a 2-day youth waterfowl hunt on Upper Turnbull Slough and Alternative 4 would provide for fall waterfowl hunting for the State general waterfowl season at Turnbull Slough and West Tritt Lake, subject to shooting hours limitations and daily closures. New areas could be designated if additional lands were acquired under both Alternative 3 and 4. Under any alternative, if hunting were to be employed, safe hunting areas would be designated away from the Public Use Area, county roads, and the Columbia Plateau Trail. No safety issues would be expected between hunters and non-hunters. There could be some disturbance which may cause animals to move around the Refuge and into the public use area or other non-hunted sanctuary areas on or off the Refuge. This would not have any significant impact on interpretive program activities.

4.2.7 INDICATOR 7 - ENVIRONMENTAL JUSTICE

Proposed public use, elk management, and land protection actions all have a low risk of adversely affecting human health, economics, or the social environment as most anticipated effects are positive. Minority and low-income populations are not prevalent in the proposed Refuge expansion areas nor in the county as a whole. Minority and low-income populations do not appear to be at risk for disproportionately adverse effects from any of the proposed alternatives for Turnbull NWR CCP.

4.3 ECONOMIC EFFECTS

4.3.1 OVERVIEW OF ECONOMIC ANALYSIS

Turnbull NWR has direct economic impacts on the local economy. Turnbull NWR has an annual budget that supports employee salaries, operations and maintenance costs and various programs. The Refuge is sometimes allocated funding for capital improvements such as building roads or facilities. All of these activities require spending by the U.S. Fish and Wildlife Service, which results in effects on the local economy.

Turnbull NWR also has an indirect economic impact on the local economy through the many recreational activities that it supports. These activities currently include wildlife viewing, photography, hiking, environmental education, bicycling, and cross-country skiing. The action alternatives also would provide opportunities for hunting. Individuals that visit the Refuge and participate in these activities buy goods and services in local towns and cities (e.g., food, lodging, fuel, equipment), and thus contribute to the health of the regional economy.

The Service requested a contractor, Jones and Stokes, Inc., to prepare the analysis of economic effects stemming from the various actions associated with the Draft CCP/EA alternatives. These effects were considered under five indicators. Each indicator addresses a different aspect of economic effects. Indicators one through three assess the direct, indirect and induced effects of the CCP alternatives on jobs and personal income within the county. Indicator one focuses only on those effects stemming from Refuge expenditures. Indicator two focuses on the effects stemming from recreational expenditures associated with the Refuge. Indicator three focuses on the effects stemming from changed land use in the county as the Refuge expands. The results from indicators one through three can be summed to deduce an overall economic effect on jobs and personal income in the county.

Indicator four addresses the tax revenue changes that would be expected under the different alternatives and indicator five focuses on the consumer surplus values ("willingness to pay") associated with each alternative.

The area of economic influence was established as Spokane County, Washington. The assessment of the economic effects was narrowed to Spokane County because Turnbull NWR is located entirely within this county; Refuge operation and maintenance expenditures would occur primarily within this county; and most visitors to the Refuge live within Spokane County and are assumed to make most of their purchases inside the county. Additionally, if the

Refuge were to acquire additional lands, these lands would also be located within the Spokane County boundary. For the purposes of this analysis, it was assumed (unless stated otherwise in each indicator analysis) that any effects attributable to the presence of the Refuge would occur only in Spokane County.

Overview of the IMPLAN Model

The economic effect of different alternatives was analyzed with the use of MicroIMPLAN (Impact Analysis for Planning), designed by the U.S. Forest Service. The IMPLAN model is owned and maintained by the Minnesota IMPLAN Group, Inc. IMPLAN is used by many state and federal planning agencies to evaluate the economic impact of policy choices. IMPLAN is based on a model known as input/output analysis. Input/output analysis uses business purchase information to discover the linkages among industries in the economy. By tracing a matrix of transactions it is possible to follow of the effects of a purchase as they flow through the economy. A purchase of seed, for example, flows back to wholesalers, truckers, seed farmers, and agricultural chemical manufacturers. This model of county-level economic interactions is used to estimate total regional economic activity based on changes in expenditures.

The IMPLAN input/output matrix incorporates data from a number of federal and state entities, including the Bureau of Economic Analysis and the Bureau of Labor Statistics. To group the industries for purposes of developing the input-output matrix and multipliers, IMPLAN uses the categories developed in the U.S. Office of Management and Budget's Standard Industrial Classification (SIC) code. The analysis was performed using the 1999 data package.

IMPLAN produces an estimate of the amount of employment (number of jobs) and the amount of personal income (dollars) that would be expected annually from the expenditure of dollars in any particular sector. Both the amount of employment and the amount of personal income are categorized as direct, indirct, or induced. These categories are defined as follows:

- *Direct effects* are the changes in production in industries producing items for which demand has changed, or which have suffered a supply shock. These are the changes specified initially by the modeler.

- *Indirect effects* are changes in production in industries linked with the directly affected industries. For example, a decrease in demand for the output of one of the directly affected industries will lead that industry to decrease demand for inputs, thereby affecting industries that supply those inputs.

- *Induced effects* are changes in household consumption resulting from changes in employment brought about by the direct and indirect effects. For example, reductions in household consumption of medical and legal services may occur as a result of decreased regional employment.

The model then sums these effects across all industries, estimating the change in regional output, employment and other indicators that would result from the initial change in output.

One weakness of input/output analysis is that it is a static model. Industries in the model do not change their production methods in response to changes in the business environment. This results in an oversimplification of how businesses and individuals respond in the real world; because of this inability of the model to account for human adaptation, economists believe input/output results represent more dramatic long-term impacts than will actually occur (Laughland and Caudill 1999).

4.3.2 INDICATOR 1 - EFFECTS FROM REFUGE OPERATIONS ON REGIONAL ECONOMY

This indicator seeks to answer the question, for each alternative: What contribution do expenditures made on behalf of Refuge operations and maintenance make to the regional economy?

Operational and Maintenance Expenditures

Since Refuge operational expenditures would vary by alternative based on the staffing levels and programs associated with each alternative (see Appendix F), each alternative would result in a different degree of economic effect. Table 4-16 shows the regional economic effect from Refuge annual operations and maintenance in the local economy. Projected average annual level of Refuge expenditures on operations and maintenance over the life of the CCP is included in the notes section of the table. It was also assumed that all operations and maintenance expenditures made by Turnbull NWR would occur in Spokane County and that all Turnbull NWR employees would reside in Spokane County.

The analysis shows that there is an enhanced economic effect on jobs and personal income from the increase in operations and maintenance expenditures under Alternative 1 to Alternative 4. Alternative 4 would produce about 50 percent more jobs and personal income as Alternative 1. The effects of Alternatives 2 and 3 are intermediate between Alternatives 1 and 4.

One-Time Expenditures

In addition to normal operations, the Refuge proposes a variety of special projects, which would generally be funded through special allocations rather than regular operations or maintenance funds. As such, they are classed as "one-time" expenditures. The projects that would be undertaken vary by alternative. Table 4-17 displays the regional economic effects from these one-time expenditures. Only high-priority projects listed in the Implementation Appendix (Appendix F) were counted towards the analysis. Assumptions that the analysis was based upon, including the average annual level of Refuge expenditures on these one-time expenditures over the life of the CCP, is included in the notes section of the table.

Note that the output of direct jobs from the IMPLAN model does not correspond exactly to the staffing levels projected by the Refuge under each alternative. IMPLAN projects the number of jobs based on an average salary of a non-military federal worker in the county of interest. This average salary over the county does not necessarily match the salaries that would be offered in the positions needed at the Refuge.

Revenues that the Refuge receives from firewood collecting, timber harvesting, and occasional other commercial uses were not included in the analysis. These revenues are small and are returned to the U.S. treasury and not the Refuge directly. In addition, it was

Table 4-16. *Estimated Employment and Annual Income Resulting from Total Refuge Annual Expenditures on Maintenance and Operations*

	Employment				Personal Income ($)			
Alternative	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
1	24	6	9	39	531,000	139,000	212,000	882,000
2	24	6	9	39	536,000	140,000	214,000	890,000
3	34	9	14	57	791,000	214,000	316,000	1,321,000
4	36	11	16	63	888,000	240,000	355,000	1,483,000

Notes: Personal income estimates have been rounded to the nearest thousand. Annual expenditures used to estimate employment and income are:

Alternative 1: $1,369,000
Alternative 2: $1,383,000
Alternative 3: $2,062,000
Alternative 4: $2,311,000

Table 4-17. *Employment and Income Resulting from Refuge One Time Expenditures on Buildings, Facilities, and Environmental Restoration Projects*

	Employment				Personal Income ($)			
Alternative	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
1	39	3	10	52	602,000	94,000	240,000	936,000
2	47	4	11	62	682,000	99,000	251,000	1,032,000
3	68	6	16	90	993,000	180,000	230,000	1,403,000
4	76	6	18	100	1,108,000	161,000	408,000	1,677,000

Notes: Personal income estimates have been rounded to the nearest thousand. Average annual level of one time expenditures used to estimate employment and income are:

Alternative 1: $1,594,000
Alternative 2: $1,668,000
Alternative 3: $2,428,000
Alternative 4: $2,710,000

assumed that these commercial uses would occur on suitable lands at comparable levels even if the Refuge was not designated.

The analysis shows that there is an enhanced economic effect on jobs and personal income from the increase in one-time expenditures under Alternative 1 to Alternative 4. Alternative 4 would produce almost double the jobs of Alternative 1. The effects of Alternatives 2 and 3 are intermediate between Alternatives 1 and 4.

4.3.3 INDICATOR 2 - EFFECTS FROM REFUGE RECREATION ON REGIONAL ECONOMY

This indicator seeks to answer the question, for each alternative: What economic value is contributed to the regional economy from the existence of the Refuge recreational facilities and programs?

Refuge recreational programs and facilities would vary by alternative. The types and quantities of visitor facilities and programs are expected to influence the number of visitors. Finally, visitation is expected to be affected by demographic changes that are expected to occur over the next fifteen year as Spokane County continues to grow. Estimates of visitation to the Refuge under each alternative and for different recreational categories are presented in Table 4-15. As evident from that table, visitation is estimated to increase under each alternative but increases in more dramatically for Alternative 4 than for the other alternatives, because of the greater emphasis in this alternative for recreational facilities and programs. As a result, Alternative 4 would result in the highest number of jobs and have the highest degree of economic effect. The net effect of recreational spending by Refuge visitors engaged in non-consumptive activities (including wildlife observation, interpretation, hiking, bicycling, and environmental education) on area employment and personal income is displayed in Tables 4-18. The net effect of recreational spending by Refuge hunting visitors (including elk and waterfowl hunting) on area employment and personal income is displayed in Table 4-19.

Two aspects of the recreational activity analysis deserve explanation. First, the analysis includes the visitors to the Refuge who reside in the local area. Section 3.6.2 of the Draft CCP/EA shows that 70-95% of visitors to the Refuge are from Spokane county. If Turnbull NWR did not exist, local residents would possibly take advantage of similar recreational opportunities nearby, such as at Riverside State Park or Mt Spokane State Park. As a result, the expenditures made by these visitors represent spending that may have taken place inside the county regardless of the existence of the Refuge, and thus do not constitute an infusion of funds into the local the economy. Hence, the analysis may overestimate somewhat the contribution of the Refuge to the

Table 4-18. *Estimated Employment and Income Resulting from Non-Consumptive Recreation at Refuge*

	Employment				Personal Income ($)			
Alternative	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
1	54	12	14	80	659,000	304,000	288,000	1,251,000
2	58	13	15	86	710,000	328,000	310,000	1,348,000
3	67	15	17	99	827,000	382,000	361,000	1,570,000
4	75	16	19	110	917,000	423,000	401,000	1,741,000

Notes: Annual non-consumptive recreation expenditures used to estimate employment and personal income are calculated by multiplying annual visitation in non-consumptive categories times a per day expeditures of $87.04. This figure was derived from Tables 25 and 33 in USFWS (2003). Total annual expenditures by non-consumptive visitors were estimated as follows:

Alternative 1: $2,861000
Alternative 2: $3,083,000
Alternative 3: $3,590,000
Alternative 4: $3,980,000

Table 4-19. *Estimated Employment and Income Resulting from Hunting at Refuge*

	Employment				Personal Income ($)			
Alternative	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
1	0	0	0	0	0	0	0	0
2	<1	<1	<1	<1	1,900	900	800	3,600
3	<1	<1	<1	<1	1,900	900	800	3,600
4	1	<1	<1	2	11,900	5,500	5,300	22,700

Notes: 1. Annual hunting expenditures used to estimate employment and personal income were calculated by multiplying annual elk and waterfowl hunting visitation times per day expeditures of $95.02 for elk hunting and $88.06 for waterfowl hunting, respectively. These figures were derived from Tables 12 and 18 in USFWS (2003). Total annual expenditures by hunting visitors were estimated as follows:

Alternative 1: 0
Alternative 2: $7,634
Alternative 3: $7,634
Alternative 4: $47,261

2. The decision to add a youth waterfowl hunt to Alternative 3 was made after the economic analysis was already completed by the contractor. The youth waterfowl hunt was not factored into the analysis. However, we estimate the economic effect of the youth hunt would be relatively minor and the overall impact on jobs and income under Alternative 3 would be somewhat intermediate between Alternative 2 and Alternative 4.

local economy. However, the recreation areas nearby provide a slightly different mix of facilities and programs than the Refuge, and habitat values are not necessarily identical. To the extent that residents would seek a recreational experience very similar to that provided by Turnbull NWR, they may travel outside the county to find it. In this case, the analysis would correctly treat expenditures associated with the Refuge as an infusion of funds because, in the absence of the Refuge, residents would go elsewhere.

The analysis assumes that all visitor purchases associated with the Refuge's recreation programs occur inside Spokane County. This may overestimate the amount of recreational spending attributable to the Refuge, as some visitors may in fact purchase some goods and supplies outside the county. For example, some Refuge visitors live out of state and may purchase items such as binoculars near their homes.

The results show that:

- Under all of the alternatives, non-consumptive recreation has a much greater effect on the county economy than hunting, and can even exceed the results from spending on Refuge operations and maintenance. This activity would account for between $1.25 million and $1.74 million of personal income and between 80 and 110 jobs, from Alternative 1 through Alternative 4. Although persons engaged in nonconsumptive recreational activities spend fewer dollars per visitor day than do hunters, the significantly higher number of visitor days spent on non-consumptive recreation compared to hunting make it a greater contributor to the regional economy. As noted in Section 4.2.1 of the Draft CCP/EA, the estimate of the annual number of non-consumptive recreation days projected for each alternative is somewhat speculative. As a result, the estimates of the regional economic impact of wildlife viewing from Turnbull NWR should be interpreted with this uncertainty in mind.
- Hunting has a very low effect on the economy ; it is projected to account for the addition of no more than two jobs and $22,700 of personal income under Alternative 4, and less than one job and only $3,600 in personal income under Alternative 2. Alternative 3 would have an intermediate effect, and there would be zero effect under Alternative 1. Unlike non-consumptive recreation, the estimates of the annual number of hunting days relatively easy to estimate; thus, the calculations of the regional economic impact of hunting at Turnbull NWR are probably fairly on the mark (see Table 4-19). By its nature, hunting (especially free-roam big game hunting) requires space. Only six to ten elk hunters can likely be accommodated safely on the Refuge at one time. Thus the actual numbers of persons who may hunt the Refuge is quite small compared to the estimates of non-consumptive visitors.

4.3.4 INDICATOR 3 - EFFECTS FROM LAND CONSERVATION ON REGIONAL ECONOMY

This indicator seeks to answer the question, for each alternative: What is the loss of jobs and income from commercial activities on private lands that might occur as the Refuge implements land conservation actions?

Land conservation or protection tools include, under all alternatives, voluntary measures taken by landowners and partners to protect and restore habitats within the Stewardship Area. This analysis does not take into account any economic changes stemming from any of the voluntary actions that might be undertaken. Alternatives 3 and 4 also include the option of protection, under the NWRS, of up to 12,000 acres, or 25,000 acres, respectively. Lands acquired by the Service could result in changed land use and thus a potential loss of commercial value. This analysis considers the economic effect from that.

The analysis assumes that all lands purchased by the Service would be either agricultural or

forest lands. Agricultural production on lands adjacent to and within the vicinity of Turnbull NWR include livestock production, hay production, and grain crops. Approximately 98% of the agricultural land within the Study Area is used for livestock grazing and the remaining 2% is planted to grain crops. Of the total agricultural lands, approximately 12% are also used for hay production. Table 4-20 show the estimated economic changes in employment and personal income resulting from transfer of a portion of these lands into public ownership and the subsequent cessation of these agricultural activities.

Alternatives 1 and 2 do not include provisions for changing the Approved Refuge Boundary but the analysis still includes the economic effect of Refuge acquisition of approximately 2,000 acres of inholdings for both alternatives over the life of the CCP. Alternatives 3 and 4 are based on an assumption that 6,800 and 9,000 acres, respectively, would be acquired by the Refuge over the next fifteen years. The analysis further assumes that all land that the Refuge acquires would have stayed in the same land uses as they are currently in and would not have been in alternative land uses (i.e. would not have been developed for housing).

Lands with timber harvest currently occurring (typically second-growth thinnings) may be acquired, however, the effects from change in land ownership into the public sector would be likely negligible. The reason is that the Refuge will continue to thin forests on Refuge-owned lands to meet the objectives of the Habitat Management Plan. In the event forest lands were to be purchased by the Service, timber production from these lands would likely continue at current levels, over the life of the CCP. Thus, no change in forest-product related employment or personal income is expected under any of the alternatives.

4.3.5 INDICATOR 4 - EFFECTS FROM LAND CONSERVATION ON LOCAL TAX REVENUE

This indicator seeks to answer the question, for each alternative: What changes in local tax revenue would be expected as a result of land transfers from private ownership into the Refuge system?

In the event that the Refuge acquires additional lands now under private ownership, property taxes would no longer be assessed to those lands. The Refuge would instead pay an annual payment known as "in-lieu-of taxes" payment, or Refuge Revenue Sharing. The net effect to the County tax base can be analyzed by comparing the two effects.

Table 4-20. *Estimated Change in Total Employment and Income Over Next Fifteen Years Resulting from a Reduction in Agricultural Production on Acquired Lands*

	Employment				Personal Income ($)			
Alternative	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
1	-5	-1	0	-6	-20,500	-11,200	-9,850	-41,550
2	-5	-1	0	-6	-20,500	-11,200	-9,850	-41,550
3	-18	-2	-2	-22	-69,800	-38,000	-33,500	-141,300
4	-23	-2	-2	-27	-92,300	-50,300	-44,300	-186,900

Notes: The reduction in agricultural production values used to estimate changes in employment and personal income are:

Alternative 1: $159,700
Alternative 2: $159,700
Alternative 3: $543,100
Alternative 4: $718,800

Potential Loss in Tax Revenue

Table 4-21 shows the expected changes in County property tax revenues and timber excise taxes expected under each of the alternatives.

Refuge Revenue Sharing

The Refuge Revenue Sharing Act of 1935, as amended, provides that the Service make annual Refuge Revenue Sharing payment (RRS - also known as Federal In-Lieu of Property Tax Payments) to counties or the lowest unit of government that collects and distributes property taxes. Payments are based on whichever of the following calculations results in the largest amount:

- $0.75 per Refuge acre;
- 25 percent of the net receipts collected from Refuge lands in the county; or
- Three-quarters of one percent of the appraised property value of the Refuge.

Table 4-22 shows the estimated annual RRS payment under each method, by alternative. The third method yields the highest RRS payment. However, historically the Service has paid only a portion of the annual total RRS payment, generally between 66 and 94 percent of the estimated total.

4.3.6 INDICATOR 5 - CONSUMER SURPLUS EFFECTS

The final indicator used to assess the economic impact of the different alternatives focuses on a concept known as "consumer surplus." Consumer surplus represents the amount an individual would be willing to pay for a good or service over and above the asking price. Individuals are often able to enjoy recreational activities at a price that is less than the amount they would be willing to pay. Thus, the consumer surplus measure captures the added benefit consumers gain beyond that reflected in the dollar value of goods and services purchased in the process of participating in these activities. Economists have developed a variety of methodologies to estimate surplus values associated with various recreational activities as well as environmental services.

The non-consumptive recreation daily value was derived from the USFWS National Survey (September 2003) Table 7. "Wildlife Watching Net Economic Values Per Day: 2001" for Washington. The value applied to estimate consumer surplus is $50/day. The wildlife

Table 4-21. *Estimated Change in Property Taxes and Timber Excise Tax Revenues*

Alternative	Land Acquired over 15 years (acres)	Change in County Tax Revenue ($)	Change in Timber Excise Tax ($)	Total ($)
1	2000	(8,400)	-159	(8,559)
2	2000	(8,400)	-159	(8,559)
3	6800	(28,560)	-531	(29,091)
4	9000	(37,800)	-715	(38,515)

Sources: Timber excise tax: Washington Department of Revene 2003.
Average per acre property tax revenue: Wentz pers. Comm.

Assumptions:
1. Assessment of loss of property tax revenues assumed only agricultural land would be purchased to expand Turnbull NWR.
2. Annual per acre property tax revenue is $4.20. Change in property tax revenue was calculated assuming that all lands were acquired simultaneously instead of over the duration of the plan.

Table 4-22. *Estimated Federal In-Lieu of Property Tax Payments*

	Method 1: $.75/Refuge Acre		Method 2: 25% of Receipts Collected from TNWR Lands		Method 3: $.0075 of Appraised Value		
Alternative	Total Acres	Total payment ($)	Annual Receipts ($)	Total payment ($)	Total Acres	Estimated Appraised Value ($)	Estimated Payment ($)
1	17,656	13,242	1,563	391	17,656	4,774,182	35,806
2	17,656	13,242	1,663	416	17,656	4,774,182	35,806
3	22,456	16,842	3,435	859	22,456	6,072,102	45,541
4	24,656	18,492	4,619	1,155	24,656	6,666,982	50,002

Notes Estimated assessed property value within the TNWR study area is $270.4/acre.

watching economic value was used as a proxy for all non-consumptive recreation because all non-consumptive recreation was treated as the same type of activity (in terms of trip expenditures) in Indicator 2 of the analysis. In addition, the USFWS did not report an estimated value for other types of non-consumptive recreation in the National Survey.

The elk hunting daily value was derived from the USFWS National Survey (September 2003) Table 2. "Elk Hunting Economic Values Per Day: 2001". The value applied to estimate consumer surplus is $76/day. Although Table 2 does not report a value for Washington, it does report a value for Oregon. The Oregon value was used as a proxy for Washington. The daily value was applied to annual elk hunting days to calculate the annual elk hunting consumer surplus for each alternative.

The waterfowl hunting daily value was based on values reported by Cooper and Loomis (1991). The value applied to estimate consumer surplus is $74/day. (Surprisingly, the National Survey did not report a value for waterfowl hunting.) The daily value was applied to annual waterfowl hunting days to calculate the annual waterfowl hunting consumer surplus for each alternative. (Note: Alternative 3 was changed after this analysis was done and does not fully reflect this value.)

Consumer surplus values for the many environmental services provided by Turnbull NWR, such as bald eagle habitat or water filtering (to take two examples), are not explicitly considered in this analysis.

The estimates of per-day expenditures used in Indicator 2 are not directly comparable to the dollar figures used to estimate the surplus value of Turnbull NWR recreation under Indicator 5. Whereas surplus value is a measure of a consumer's willingness to pay for an activity over and above current expenditures on that activity, the estimates used in Indicator 2 reflect the actual expenditures made by recreators. The two analyses serve different purposes. Whereas the analysis of the surplus value reflects the net societal value of the recreational experience itself, the regional economic model estimates the contribution of recreation to the regional economy.

Table 4-23 displays the consumer surplus value for each alternative.

4.3.7 SUMMARY COMPARISON

Table 4-24 summarizes the economic effects that would result from implementation of the alternatives. This table includes the losses in jobs and personal income as a result of the loss in agricultural production, offset by the expected increases in jobs and personal income

associated with increased refuge expenditures and increased visitation to the Refuge. It integrates the analysis under Indicators 1, 2, and 3.

Under all alternatives, there would be a net positive effect to the economy of Spokane County. The largest number of jobs and largest increase in personal income would be realized through implementation of Alternative 4, and the smallest number of jobs and personal income from Alternative 1. Alternatives 2 and 3 would have intermediate effects.

Approximately 324,000 persons were employed in Spokane County in 2000 (US CENSUS). Although each alternative would result in a net increase in the number of jobs in the county, this increase would not be significant for the county economy as a whole, with less than a 1% increase in jobs for any of the alternatives considered.

The total personal income in Spokane County in 2000 was approximately $10.7 billion. Similarly to the net increase in jobs, each alternative would result in a net increase in personal income to the County. Again, this increase represents less than a 1% increase under any alternative and thus is not significant to the county economy as a whole.

Table 4-23. *Estimated Annual Recreation Benefits (Consumer Surplus) at Refuge*

	Non-Consumptive Recreation			Elk Hunting			Waterfowl Hunting			
Alternative	Visitor Days	$/Day	Total	Visitor Days	$/Day	Total	Visitor Days	$/Day	Total	**Total**
1	32,875	50	1,643,750	0	76	-	0		-	1,643,750
2	35,425	50	1,771,250	80	76	6,080	0		-	1,777,330
3	41,250	50	2,062,500	80	76	6,080	0		-	2,068,580
4	45,725	50	2,286,250	80	76	6,080	450	74	33,300	2,325,630

Sources:

Non-consumptive recreation value/day: USFWS 2003
Elk hunting value/day: USFWS 2003
Waterfowl hunting value/day: Cooper and Loomis 1991

Table 4.24. *Summary of Effects to Employment and Personal Income, by CCP Alternative.*

	Employment				**Personal Income ($)**			
Alternative	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
1	112	20	33	165	1,771,500	525,800	730,150	3,027,450
2	125	23	36	182	1,909,400	556,700	765,950	3,232,050
3	152	29	46	225	2,543,100	738,900	874,300	4,156,300
4	165	32	52	248	2,832,600	779,200	1,125,000	4,736,800

4.4 EFFECTS TO CULTURAL RESOURCES

4.4.1 INDICATOR 1 - EFFECTS TO ARCHAEOLOGICAL AND HISTORICAL SITES

Effects from land protection actions

Acquisition of land by a Federal agency is not considered an undertaking with the potential to affect historic properties under the National Historic Preservation Act (NHPA), therefore acquiring additional lands within the current Refuge boundary and expanding the Refuge boundary are not considered effects to cultural resources. Off Refuge stewardship projects that use federal funding, permitting, or licensing are covered by NHPA. These projects are required to have a cultural resource professional determine the project's potential to affect cultural resources, and if needed, appropriate actions to mitigate effects. Alternatives 2, 3, and 4 would have a greater potential to affect cultural resources off the Refuge due to the larger size of the Stewardship Area for these alternatives compared to Alternative 1. Whether these impacts are positive or negative depends on many factors including the presence or absence of cultural resources on a particular property. Where cultural resources are present, ground disturbing actions, such as deepening a wetland, could have negative impacts. However, maintaining existing habitat conditions for native wildlife, instead of developing a site, would in most cases be positive for cultural resources. In general, the larger Stewardship Area is likely to be more beneficial to cultural resources.

Effects from Elk Management Actions (Not including hunting)

There are no anticipated impacts to cultural resources from potential elk management actions.

Effects from Public Use Actions

Construction, maintenance, and use of public facilities can have negative impacts to archaeological and historical sites. There are known cultural resource sites as well as unsurveyed areas along proposed new public use routes and facilities. Care in final siting of these facilities will be needed to minimize impacts.

Cultural resource protection procedures, which are required by NHPA for each project at the site specific level, are designed to reduce impacts from human activities. The potential to impact cultural resources and the workload for a cultural resource professional to implement cultural resource protection procedures would be greatest for Alternative 4 and decrease for the other alternatives to Alternative 1 which has the smallest size and quantity of new projects.

Vandalism or "pot" hunting is always a threat to cultural resources especially in areas open to the public. Under Alternative 1, the risk of vandalism to cultural sites would increase proportionate to an expected increase in use of the Refuge. For the other alternatives this would also be true on Refuge lands, with an additional increased use risk associated with more facilities (trails, pullouts, photo blinds, etc) and public use opportunities (biking, hiking, environmental education, hunting, etc.). Alternative 4 would have the greatest risk of vandalism to cultural resources on Refuge lands because it proposes the greatest quantity of public use facilities and activities. Alternative 3 would have only slightly less risk than Alternative 4; Alternative 2 would be intermediate; and Alternative 1 would have the least risk relative to the other alternatives. However, risk to cultural resources that may be currently unprotected within the Study Area could be lower under Alternatives 3 and 4, as there would be a much higher likelihood under these alternatives that lands would be permanently protected from development.

4.4.2 INDICATOR 2 - OPPORTUNITIES FOR CULTURAL RESOURCE EDUCATION AND INTERPRETATION

Promoting an understanding of human prehistory, history, and associated interactions with the natural world is an important part of the Service's cultural resource programs. Expansion of the Refuge boundary in Alternatives 3 and 4 increases the opportunity to purchase, and therefore interpret, known cultural resource sites as well as any as yet undiscovered sites within this area. Under Alternative 1, cultural resource education is already a component of the current environmental education program on the Refuge. Increasing the environmental education program in all of the action alternatives would provide many additional opportunities and a larger audience for cultural resource education. A few of these opportunities are: interpretation along the Columbia Plateau Trail of the historic Spokane, Portland & Seattle (SP&S) railroad and its role in development of the West, educational pamphlets focused on reducing cultural resource vandalism, and using actual Refuge artifacts to help create replica kits for a teachers lending library. As a whole, opportunities for cultural resource education and interpretation would be greatest with Alternative 4 and decrease for the other alternatives in numeric order to Alternative 1.

4.5 MISCELLANEOUS EFFECTS

It is expected that the existing road system on the Refuge will accommodate the current and anticipated use for the foreseeable future. However, if in the future the road system can no longer handle the increased use, road projects such as widening and adding turnouts, parking, and facilities, may be developed to address these needs.

4.6 CUMULATIVE EFFECTS

This section addresses the potential cumulative effects for all of the alternatives and is intended to consider the activities proposed under the CCP within the context of other actions on a larger temporal and spatial scale. In addition, this section considers the inter-related effects from the alternative actions on biological integrity, environmental health, and biological diversity. Under NWRSIA, The National Wildlife Refuge System is clearly mandated to maintain the first three attributes for the benefit for present and future Americans. In addition, NWRSIA mandates that Refuges shall facilitate opportunities for compatible wildlife-dependent recreation.

There is a clear trend in Spokane County of increasing development and associated habitat loss. Additional residential and commercial development could occur over the next fifteen years within the Study Area and at higher levels within the Refuge vicinity, especially to the northeast of Refuge lands. Regional and State trends also show an increase in public desire for outdoor recreation in all types of recreation potentially supportable at the refuge, except for hunting.

Alternative 1

The Refuge would continue to undertake wildlife habitat improvement projects on its lands and would work, with limited resources, to promote conservation within a smaller Stewardship Area surrounding the Refuge. Public uses would continue to grow at current rates but few additional improvements in facilities would be undertaken to support this use. Hunting, one of the priority public uses of the Refuge System, would not occur. With limited resources to affect actions within the Study Area, additional development surrounding the Refuge would occur at the current pace. This would increase fragmentation of existing habitats, further isolating the Refuge and diminishing its biological integrity and environmental health (particularly with relation to water quality and

quantity). Biological diversity (the number of species present on the Refuge) would likely remain unchanged over fifteen years, though invasive species could become more prevalent within the vicinity and additional protection for rare species would be low. Public opportunities for wildlife-dependent recreation would remain at similar levels, though the quality of the experience could decline over time.

Alternative 2

The Refuge would continue to undertake wildlife habitat improvement projects on its lands and would work, with greater resources than under Alternative 1, to promote conservation within the larger Stewardship Area designated under this Alternative. A moderate increase in public facilities and trails would support the growth trends in visitation for all wildlife-dependent uses. Elk hunting, a new Refuge use and a priority public use under the National Wildlife Refuge System, would occur. With additional resources to affect actions within the Study Area, additional development surrounding the Refuge would occur but at a slower pace than under Alternative 1. Fragmentation would continue to occur. Overall, Refuge biological integrity and environmental health would continue to decline, though more slowly than under Alternative 1. Biological diversity (the number of species present on the Refuge) would likely remain unchanged over fifteen years, though invasive species could become more prevalent within the vicinity and additional protection for rare species would be moderate. Public opportunities for wildlife-dependent recreation would increase and the quality of the experience would remain relatively stable.

Alternative 3

The Refuge would continue to undertake wildlife habitat improvement projects on its lands and would work, with greater resources than under Alternative 1, to promote conservation within the larger Stewardship Area designated under this Alternative. The capacity to add up to 12,000 additional acres to the Refuge by fee or conservation easement would increase the effectiveness of habitat protection and restoration. A larger increase in public facilities and trails would support the growth trends in visitation for all wildlife-dependent uses and potentially attract new visitors above growth rates. Elk hunting and youth waterfowl hunting, both new Refuge uses and priority public uses under NWRSIA, would occur. With additional resources to affect actions within the Study Area, the biological integrity of the Refuge would stabilize or increase. Environmental health on the Refuge and within the vicinity would improve. Biological diversity (the number of species present on the Refuge) would likely remain unchanged over fifteen years, and invasive species could decline within the vicinity. Additional protection and restoration for rare species would occur. Public opportunities for wildlife-dependent recreation would increase, including for elk and waterfowl hunting. Some impact to Refuge wetlands would occur from the increase in public uses, but the impact to other habitats would be less than under Alternative 1.

Alternative 4

The Refuge would continue to undertake wildlife habitat improvement projects on its lands and would work, with greater resources than under Alternative 1, to promote conservation within the larger Stewardship Area designated under this Alternative. The capacity to add up to 25,000 additional acres to the Refuge by fee or conservation easement would greatly increase the effectiveness of habitat protection and restoration. A large increase in public facilities and trails would support the growth trends in visitation for all wildlife-dependent uses and likely attract new visitors above growth rates. Elk hunting and waterfowl hunting, both new Refuge uses and priority public uses under NWRSIA, would occur. With additional resources to affect actions within the Study Area, the biological integrity of the Refuge would increase. Environmental health on the Refuge and within the vicinity would improve. Biological diversity (the number of

species present on the Refuge) would likely remain unchanged over fifteen years, and invasive species could decline within the vicinity. Much enhanced protection and restoration for rare species would occur. Public opportunities for wildlife-dependent recreation would increase, including for elk and waterfowl hunting. Some impact to Refuge wetlands would occur from the increase in public uses, but the impact to other habitats would be less than under Alternative 1.